IN THE HOME COUNTIES: A TYPICAL HERTFORDSHIRE SCENE

The
Nature Lover’s
Companion

THE COUNTRYSIDE OF BRITAIN,
ITS FLOWERS, TREES, AND WILD LIFE,
ILLUSTRATED
AND SIMPLY DESCRIBED

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COLOUR PLATES

FRONTISPIECE: C. S. Gould

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Nature and the landscape

MOST PEOPLE take the countryside for granted. They see the green fields and the trim hedges, the wild flowers and the trees, and think of them all as part of the wonders of Nature. So they are in a sense, but they are not in the least haphazard. There is a plan behind them all which we can find out for ourselves if we know how to look for it.

The village nestling in a valley amid low rolling hills with a mixture of ploughland and green pastures is a scene typical of a great part of central England. The crops have been cleared and autumn ploughing has begun, showing that here the farmer's year is starting early.

There is, first, the actual shape of the hills and valleys. That is something which is essentially Nature's handiwork, although we have to go back millions and millions of years to discover how the crust of the earth first took shape and how it has been modified by Nature through the ages. But the shape of the hills and valleys, the twisting course of the rivers, the distant views of high mountains—those are only the barest outline of the country scene.

If we saw the landscape of Britain without its covering of growing things we should probably not recognize it. In determining what shall grow in the country, Nature and man have both had a share. Nature's part consists in providing the soils; certain kinds of plants and trees will grow only in certain soils, and we can usually tell what kind of soil there is by noting what grows in it. Nature also takes a hand by determining the climate, by which we mean how much rain falls and how often it falls, how much sunshine there is, and so on. All these things help to decide what kind

Rain falling on the bare, windswept mountain slopes runs off quickly into the swift-flowing streams which cut deep valleys through the hills. The waterfall is caused by hard rock wearing away only slowly, while softer rock is more quickly broken and carried away by the water. In the lower reaches the river broadens and flows more slowly. There is little vegetation on the mountains, but as the river reaches lower and more sheltered ground trees and plants become more numerous.

of crops will grow in any country and how readily they will grow. Then man takes a hand by cultivating the land and by building farmhouses and villages and towns, by dividing the countryside into fields and in a hundred other ways—a process which changes the pattern originally set by Nature.

So whenever we look at a rural scene we can first of all distinguish how much of it is due to Nature, how much to man's work and industry. It will lend a great deal of added interest to our journeys, whether we are going from one village to the next on foot, or going farther afield by road or rail, to look in this new way at the landscape.

Before we can do this with any certainty we must know something about climate and its effects, and about the subject which scientists call geology—the study of the earth's crust and the rocks which are under the topsoil.

Great Britain is a country which has

within its comparatively small area a great variety of climate. On the whole it is wonderfully fortunate in having what is called a temperate climate, with just enough moisture and just enough warmth to allow most things to grow well and come to maturity before the summer is over, so that they can be harvested and stored for use in the following year.

The climate of Britain makes its scenery what it is, and makes it different on the one hand from the great deserts of the world and on the other from the vast and impenetrable forests of tropical lands like the Amazon Valley, where there is too much moisture and the heat is too great for man to be able to conquer the forces of Nature.

People sometimes speak of a "typical" English scene. In fact, the scenery varies very greatly within England and still more so over the larger area of Great Britain. This variation depends to a great extent on differences in rainfall. In the eastern counties the rainfall is small—under twenty-four inches a year in places, compared with totals which approach two hundred inches in some very exposed parts of the mountains of Wales and Cumberland.

Wheat requires a great deal of sun-

shine and comparatively little rain. Therefore, the fertile fields of East Anglia and of the east Midlands are the granary of Great Britain. All over Norfolk and Suffolk in late summer you will see fields of waving wheat mixed with occasional fields of oats and hundreds of acres under root crops. Only here and there will you find pasture-fields—and these are mostly near large towns—where there are herds of cows to ensure the milk supply of the people who live in the towns.

What a different picture it is for the traveller in the West Country. There you will see very few fields of wheat, though there will be some oats and barley in sheltered valleys, because these crops require much less sunshine and can withstand much heavier rainfall than wheat. Elsewhere you will see mile after mile of grass fields, the grazing ground of cattle and sheep, with mostly sheep on the hills and cattle on the lower ground, with the dairy herds in the rich pastures bordering the rivers.

CORN CROPS

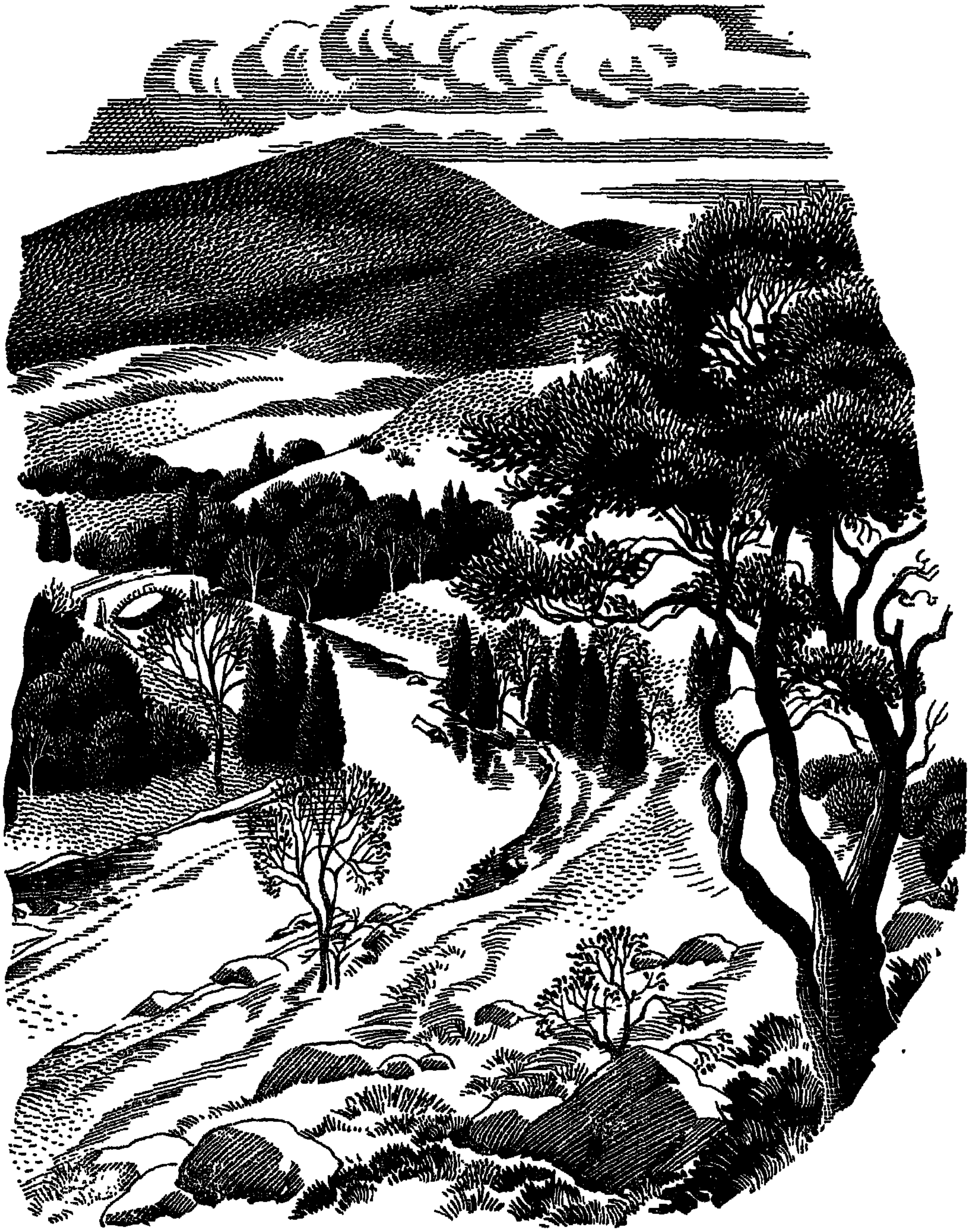
In Scotland the summer climate is a good deal cooler than it is in England, and here, as in England, the rainfall decreases from west to east. The lowlands, and the plain which lies along the east coast, and the valleys which extend inland from it toward the mountains, are the only districts where you will find corn crops on a large scale.

Corn is a word which is used to describe many crops, as well as one which embraces all the cereals. When citizens of the United States of America speak of corn they mean maize, because maize is their staple food crop. When English people refer to corn they generally mean wheat, because wheat is the traditional bread crop of England and the most important for human consumption. In Scotland corn generally means oats. The traditional Scottish dish of oatmeal won its great popularity north of the border because oats is the chief crop which Scottish farmers can cultivate with success.

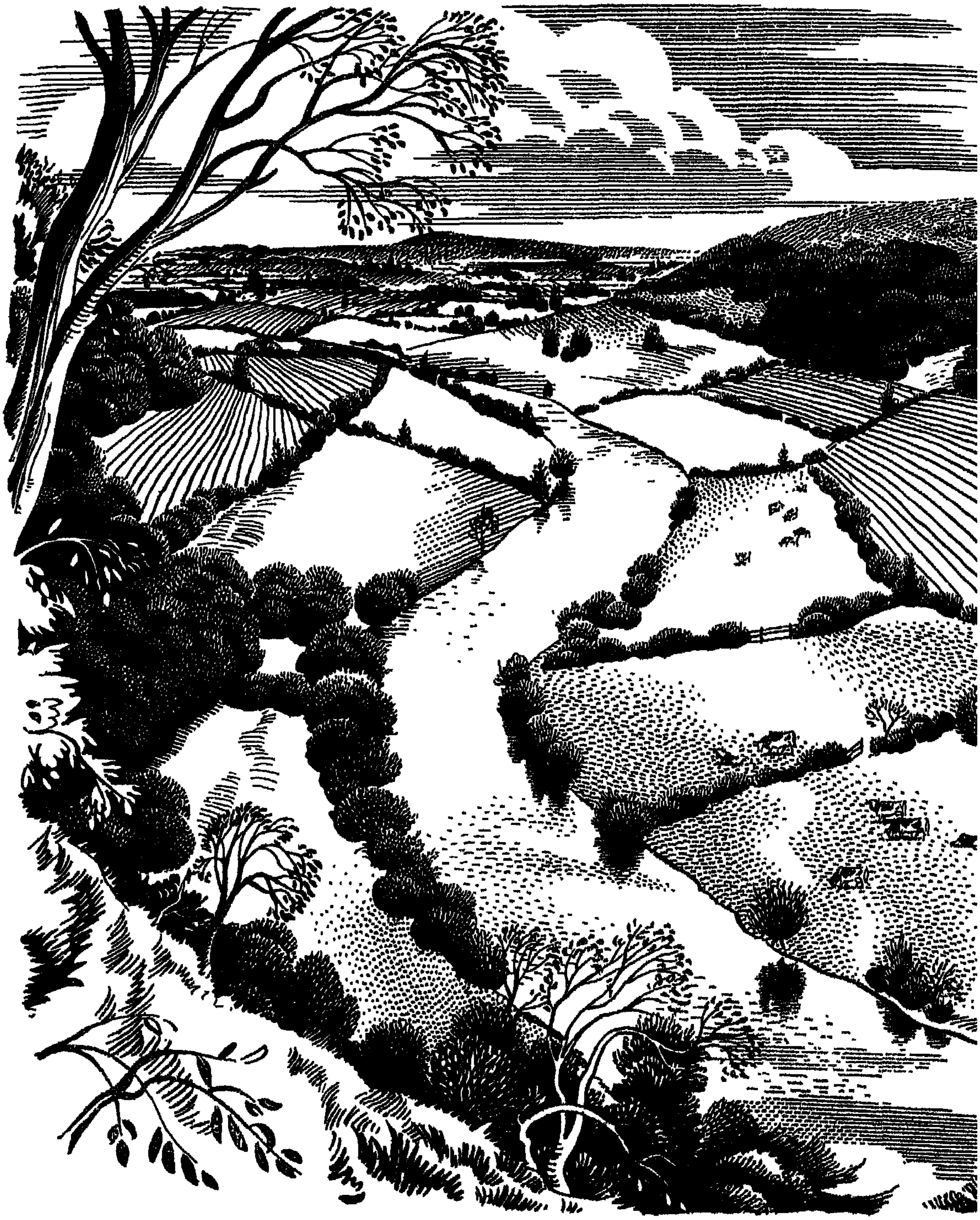
PASTURE-LAND

The climate of west and north Scotland is much too severe for even oats to grow except in a very few places, and here the land is nearly all pasture. On the higher ground it is rough pasture at that, suitable for only hardy breeds of sheep.

In some places you can get a very dramatic picture of the difference which climate makes. If you stand in a long, deep valley, like the valley of the Wye or the upper reaches of the Severn, you will see that the cultivation of the land is in steps up the hills on either side of the river. First there will be a strip of water-meadows, then as you look higher up the hill you will see a strip of ploughed fields, above that again woodland, and finally, on the highest ground, more grass fields, much rougher than those nearer the river, with sheep or mountain cattle grazing over them. Here you have four distinct kinds of agriculture, equated as it were with four different levels. The reason for the difference is chiefly the variations in climate, for the higher the ground the



Some of the loveliest of Scottish scenery is along the banks of the River Dee. Here, near Braemar, the fast-flowing river has started to broaden. The woods and coppices along the banks contrast with the bare outline of the higher moors in the distance.



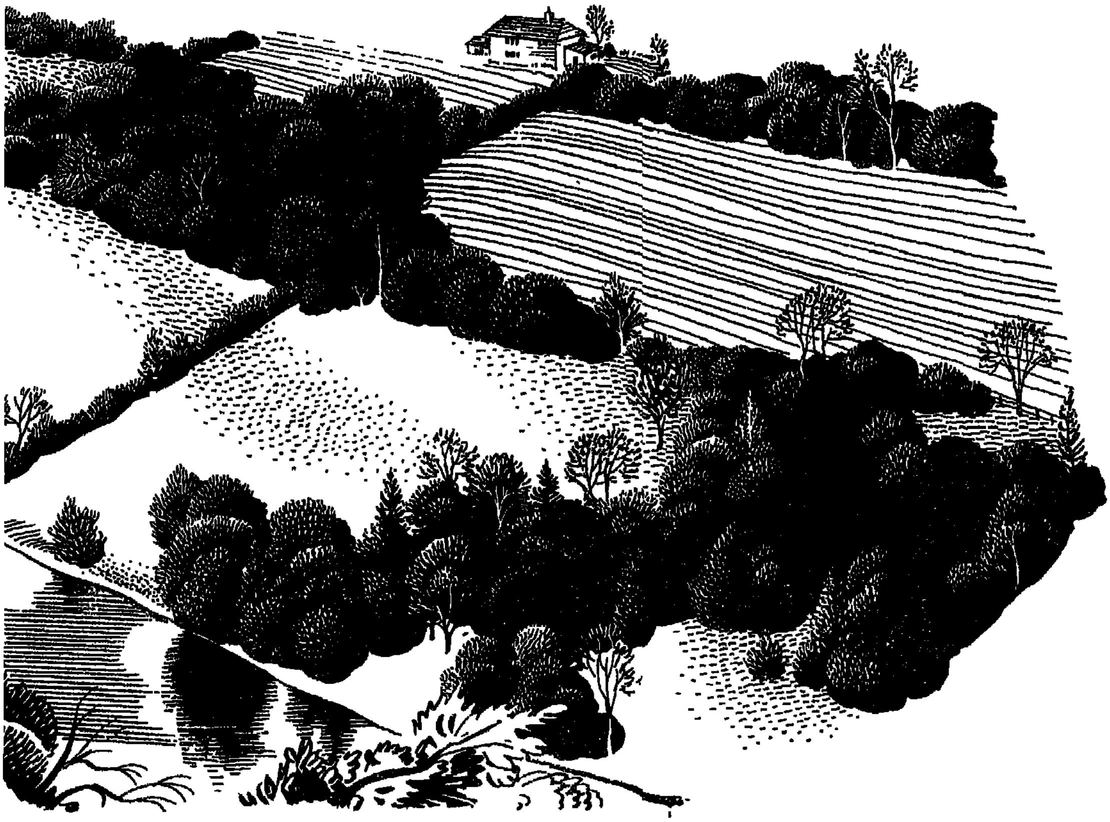
This part of the valley of the Wye shows how farming is influenced by soil and climate. Near the stream where the land is fertile but liable to flooding are meadows; above them, out of reach of floods, is a strip of ploughed land, and on the higher and colder slopes there is rough pasture-land.

more rainfall there is likely to be and the less warmth.

The fields by the river's brink cannot grow crops because they are liable to flooding, but they grow magnificent grass, either for hay or for grazing dairy herds. The strip of ploughed fields is just out of reach of the flood-water. On the highest ground, quite apart from the fact that the soil is likely to be much thinner, the climate is too cold and wet for either pasture-fields or corn crops; here the farmers make what use they can of the rank grass in the only way open to them—by putting out for rough grazing their flocks of sheep or herds of hill cattle. These range over wide areas instead of being confined to small fields, like the dairy herds which graze near the river.

The nature of the soil is almost as important as the climate. You have probably heard people talking about good soils and bad soils, especially when they are speaking of what they can grow in their gardens. But have you ever wondered why one soil is good and another bad? This difference of soils decides what sort of plants can grow and so settles the kind of scenery for each place.

The soil is composed of fragments from the rocks which lie under the soil. To understand this we must remember that the earth as we know it is in a constant state of being worn away



England is under constant attack by the sea. As the water washes against the cliffs it gradually wears them away. Soft material like chalk is eroded comparatively quickly. When the foot of a chalk cliff has been undercut the part left overhanging will eventually collapse. In this way the sea eats its way into the land. When the rock of the cliff is hard like granite, rock falls are less likely, but then the cutting action of the sea can make caves which may extend far into the rock. In the drawing is shown part of a cliff which has become liable to collapse; it has been railed off and a notice-board set up to warn people of the danger.

and built up again. Most of Britain, and many other countries of the world, is composed of rocks which were formed under the bed of the sea and then lifted up by some giant upheaval of Nature into something like the shapes of the hills and valleys that are now so familiar. Once this great upheaval had taken place, Nature began to wear away the hill-tops and remould the surface of the land. The old proverb, "Constant dripping wears away a stone," is very true. The rainfall on the hill-tops literally wears away or breaks off fragments of the hill, and these fragments, many of them no larger than specks of dust, are carried down the hill by mountain streams and deposited many miles from the start of their journey.

In dry, frosty weather you have probably seen wide cracks appear in the fields near your own home. Sometimes, too, in summer the ground gets very hard, and when there has been no rain for a long time small cracks appear. When the ground is cracked like this, particles are easily carried away by the wind. When the wind blows during a hot, dry spell in summer you will see little clouds of dust whirling round near the ground. In fact, there is a tremendous amount of dust in the atmosphere, its particles being so small that you cannot see them one by one. It is this dust which makes the sun look red when it is setting, because the dust absorbs a great deal of the sun's light.

The dust that is carried along in the atmosphere comes down to earth when it rains, or if the wind drops to a dead calm, as it so often does after sunset.

In these and many other ways Nature is constantly breaking up the rocks and carrying them away by air and water to deposit them somewhere else. These minute fragments of rock compose the soils wherever they are, whether in garden or field or woodland. Some soils are formed "on the spot," as it were, by the breaking up and powdering of the rock, others are formed at a distance by the fragments which are deposited in the ways already described.

There are five principal kinds of rock in Britain (though there are also many other less important ones). Each one is linked with a distinctive type of scenery. These five rocks are granite, clay, sandstone, limestone, and chalk. Each of these has different properties and different virtues for growing things. In general, many of the things that will grow in one kind of soil will not grow in another.

The most famous granite country of Britain is in the south-western counties. Dartmoor in Devonshire, Bodmin Moor in Cornwall and the rocky promontory of Land's End are all granite. They are, in fact, the remains of three great mountains thrown up hundreds of millions of years ago and now worn away to their present modest heights.

As granite is a very hard rock it can withstand the effect of weather better than many other softer rocks, and does not break up into small fragments so easily.

The result is that the soil on the high ground is very thin. In a few places there is no soil at all and the granite rocks are exposed. These are the tors of Dartmoor, which stand out bare and grim against the skyline, with no vegetation on them at all—not even the rank grass which is all that will grow in the surrounding countryside. There are no ploughed fields in the uplands of Dartmoor and Bodmin Moor, but only rough pasture for sheep and cattle which roam almost wild on the moors.

The sea has cut the archway through this pinnacle of chalk. The water washed away soft rock from the middle, and some of the soil above, unable to stand by itself, collapsed. In this way, usually in hard rocks, the sea can make caves.

Sandstone is one of the rocks found most frequently, especially in the southern half of England. There is a family resemblance between sandstone and the sands of the seashore. You may have noticed how quickly the sands dry when the tide goes out and the sun is shining. Exactly the same is true of sandstone soils. For the most important characteristic of sandstone is that it is very porous—that is to say, its particles are small and less closely bound together than the particles of many other soils. So they not only let the rain through and let standing water drain away, but they let the air and sunshine into the soil, so that the moisture in the top layer dries out quickly.

HEATHER AND BRACKEN

Sandstone soils, therefore, are dry, and in them can grow no plants which require a great deal of moisture, neither can plants which are without means of storing the moisture which enables them to survive a long drought.

So we shall find that where the soil is very sandy most of the land is heath. Heather and bracken flourish, for their roots go deep into the soil in search of moisture—far deeper than the roots of corn crops, for instance. Apart from heather and bracken, evergreen trees and shrubs, which are much hardier and need less rain than Britain's forest trees, do well in the sandstone country. The Douglas fir and various other kinds of pine which the Forestry Commission have planted in long rows in country which was previously barren have proved how well this kind of tree is adapted to the dry soils. Some of the finest rhododendrons, too, flourish in sandstone country, and their blossoms are a blaze of glory in the late spring.

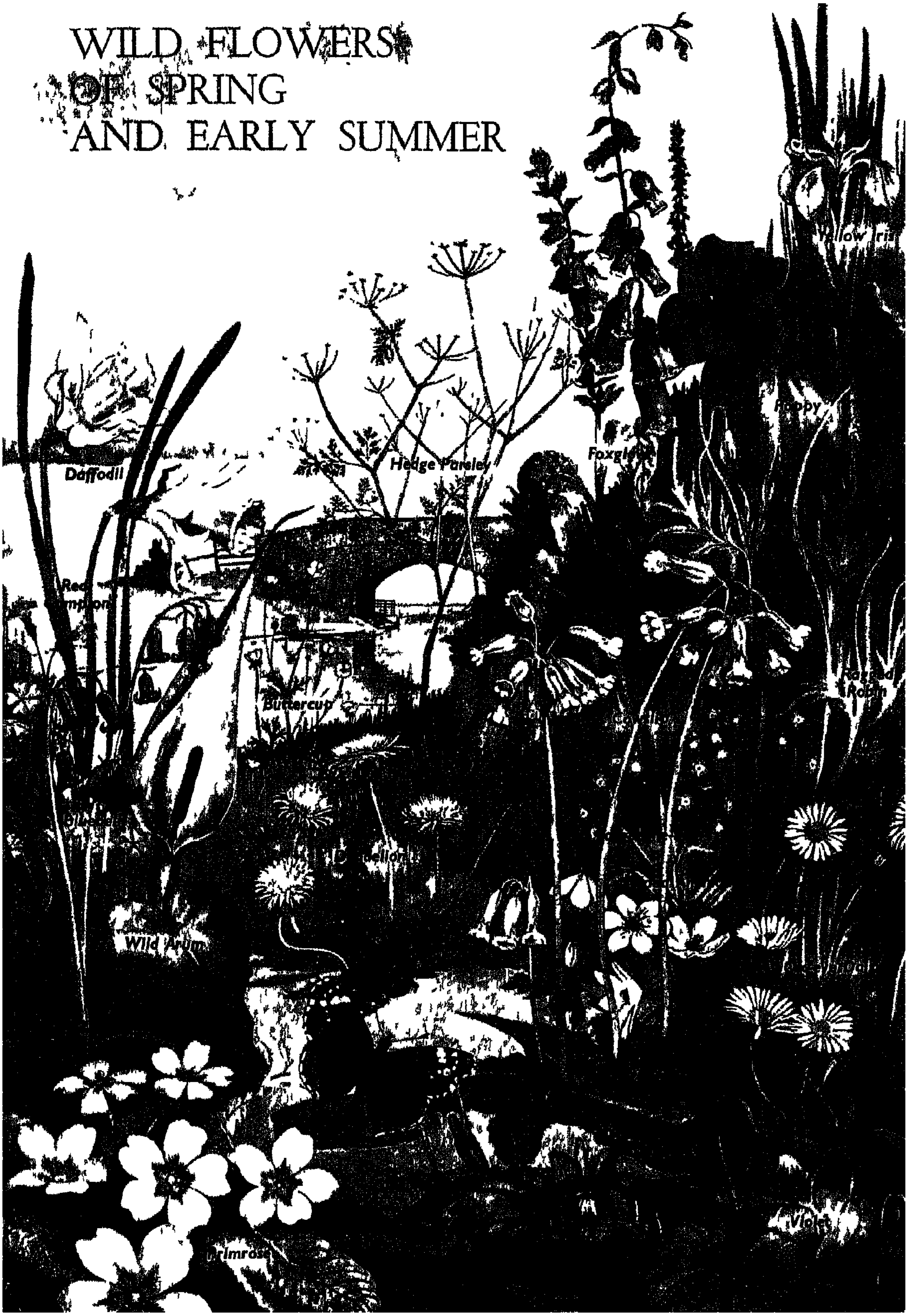
Breckland, on the Suffolk–Norfolk border, is an example of sandy soil. This stretch of country is not easily recognized by anyone who has not seen it for twenty years. Right through the ages it defied the efforts of farmers to cultivate it. After the First World War the Forestry Commission began to plant pine trees, and today there are many square miles covered with thick forest which one day will give the tree-fellers magnificent timber.

Sandstones are not all of the same colour. Most of them are reddish grey, rather like the sands of the seashore, but in some parts, as in Devonshire, where older sandstones are the underlying rocks, the colour is a much brighter red. It is the old red sandstone which gives the colouring of south Devon landscapes such vivid hues and such an unforgettable beauty.

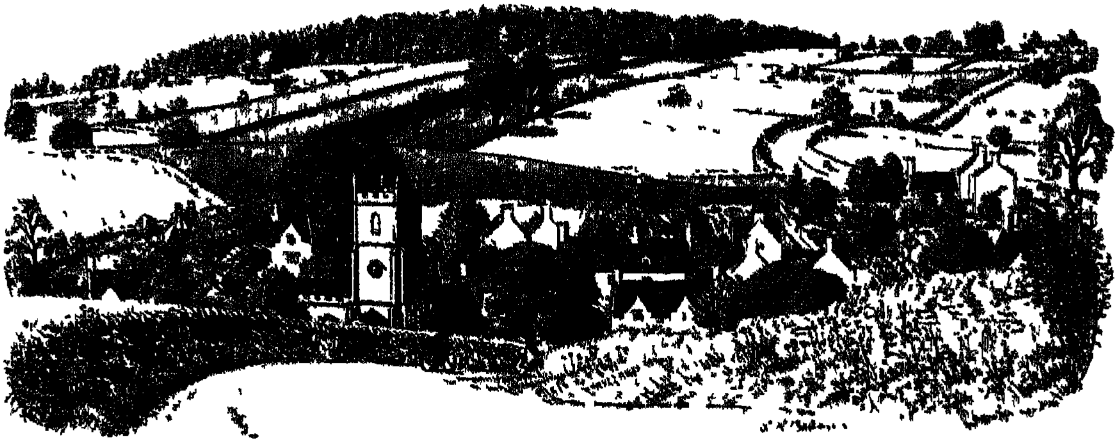
RICH SOIL

Clay soils are just the opposite of sandstone because they hold moisture for a long time. If you have been walking in the country in winter you will quickly come to recognize clay soils because of the sticky mud, often six inches or more deep, which lies on all the cart-tracks and paths. For four or five months of the year it never dries out and seems to stay as wet as ever, even if it has not rained for a week or two. Clay soils are the ones you will most often find in England and Wales, and there

WILD FLOWERS OF SPRING AND EARLY SUMMER



Rich clay soil makes East Anglia and the East Midlands the granary of Great Britain



Limestone is warm grey in colour and fertile, crops grow on all but the highest ground

Old red sandstone gives colour and beauty to the landscapes of south Devonshire

THE NATURE OF SOIL

Chalk country has on high ground bold ridges and short springy turf ideal for sheep pasture.

Sandstone soils dry quickly, heathland is common on them because only deep-rooted plants thrive

Granite wears away slowly; the soil is thin, suited only to rough pasture.

WILD FLOWERS OF LATE SUMMER AND AUTUMN

are often beds of clay in the midst of sandstone or chalk country.

Because clays retain their moisture so well, almost anything will grow in this type of soil. All Britain's valleys have a lot of clay soil, and some of the very best farming country is where the soil is composed of clay mixed with other rocks, like sandstone or limestone. The Midland Plain of England, East Anglia, the Weald of Kent, the Vale of Evesham, the Lowlands of Scotland, the Vale of York, the Fylde of Lancashire—all these are clay, or partly clay. Think of any other famous valley where the farmers are prosperous and the crops are rich. The chances are that it has a clay soil.

The great forests of olden days, in which trees like the oak flourished for hundreds of years, all lay in areas of clay, including the forest of Waltham, which once covered all Essex, and the forest of the Weald, which filled most of the country between the North Downs and the South Downs.

CHALK HILLS

Some clay soils, of course, are too heavy and too thick for crops to grow in readily. They hold their moisture too long and become waterlogged in winter. But even these will usually prove fertile if they are drained by ditches and artificial channels.

Most people who live in southern England are familiar with the chalk hills and with their distinctive appearance. The close-cropped, springy turf on the high ground, the bold, bare whaleback ridges going on for miles without a single tree, the few ploughed fields on lower ground gleaming white in the sun, their surfaces almost covered in shining flints—those are the signs by which you will know the chalk country, whether you are visiting the South Downs or the North Downs, the Chiltern Hills or Salisbury Plain. Where the downs are broken off at the sea, as they are near Dover in Kent and Beachy Head in Sussex, you will see the sheer chalk cliffs rising white and dazzling for hundreds of feet.

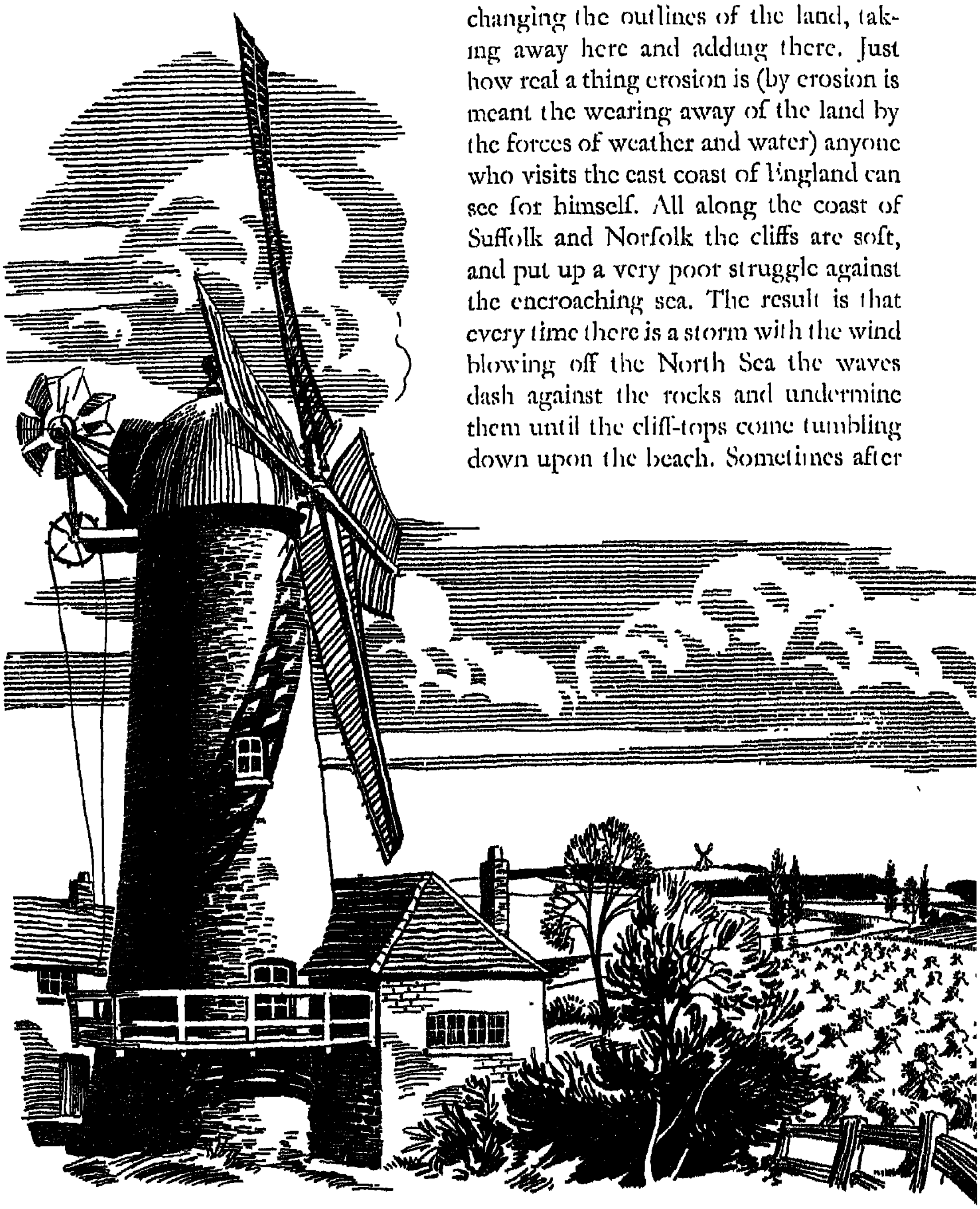
THE COTSWOLDS

The limestone country is at its best in the Cotswold Hills, which stretch from Somerset through Gloucestershire into Northamptonshire. The soil is a warm grey in colour, and though the hills are a little like the chalk downs, they are much more fertile, and you will find crops on all but the highest ground.

The mountains of Wales and Scotland do not belong to any of these types of landscape. Their rocks are much older, and weathering through the ages has moulded them into fantastic shapes. The bare rock is often exposed, as it is in the tors of Dartmoor, only on a much larger scale. The countryside is always rugged, and it is hard for the farmers to draw a living from the soil. Visitors often think the highlands are unkind and feel that the mountains are frowning down on them, but people who have been born and bred among them come to love their country as much as anyone who has lived in the sunnier and richer country of the south and east.

Nature is busily at work all the time

changing the outlines of the land, taking away here and adding there. Just how real a thing erosion is (by erosion is meant the wearing away of the land by the forces of weather and water) anyone who visits the east coast of England can see for himself. All along the coast of Suffolk and Norfolk the cliffs are soft, and put up a very poor struggle against the encroaching sea. The result is that every time there is a storm with the wind blowing off the North Sea the waves dash against the rocks and undermine them until the cliff-tops come tumbling down upon the beach. Sometimes after



The appearance of the flat farmlands of East Anglia is sometimes monotonous, but the rich soil makes it a most fertile area. The corn stooks and the windmill are reminders that it is the best wheat-growing region in all England.

a big storm the cliff-face has receded six feet or more. Whatever is on top of the cliff comes down in the fall—trees, houses, and even whole villages. At least one flourishing seaport has been immersed in the sea since the Middle Ages, the port of Dunwich, which today is no more than a farm or two and a few cottages where once it was as big a port as any along the Suffolk coast.

Sometimes the sea breaks right through the cliffs and floods the low-lying ground behind. If this were allowed to go on, a great deal of the inland parts of Norfolk and Suffolk, particularly round Yarmouth and Lowestoft, would become salt-marsh, incapable of being cultivated and useless to man and beast. So during the last fifty years elaborate coast defences have been organized. Great concrete walls have been built to strengthen the base of the cliffs, real barricades against the attacking sea. But it is always a losing battle that man fights against the forces of Nature. The coast defences last for a time, then some very heavy storm sweeps them away and the task has to be begun all over again.

Even though man builds up defences in one place, the sea encroaches at some other point along the coast. There are never enough men or materials to build a sea wall all round the coast of Britain

strong enough to keep out the sea at its stormiest. It would take millions of tons of concrete and hundreds of thousands of men working for year after year to achieve something which even then might not be effective.

That is one side of the picture—the destructive force of Nature. But Nature is also a builder of new lands. The tides of the North Sea and the English Channel carry tons of shingle round the coast and deposit it at a point where the currents meet. The whole promontory of Dungeness in Kent has been built up in this way. All the sand dunes round the south coast, reaching sometimes a mile or more inland, were once washed by the waves. Where a river comes down from the hills and brings with it earth and stones when it is in flood, it deposits these, too, at the estuary and helps the sea currents to manufacture new land.

This is a good thing in one way, because it gives more land to the farmers to graze their cattle over, or perhaps, when richer soil has covered it, to grow crops on. But it is sometimes a bad thing when seaports are left high and dry well inland, like the old towns of Rye and Winchelsea in Sussex. Two or three hundred years ago the waves washed against the cliffs on which these towns are built. Today if you look out to sea from the Ypres Tower at Rye you will see miles of grass-covered marshes with the blue of the sea only distantly to be discerned on the horizon. All the land between you and the sea has been formed during the last few hundred years in the way described.

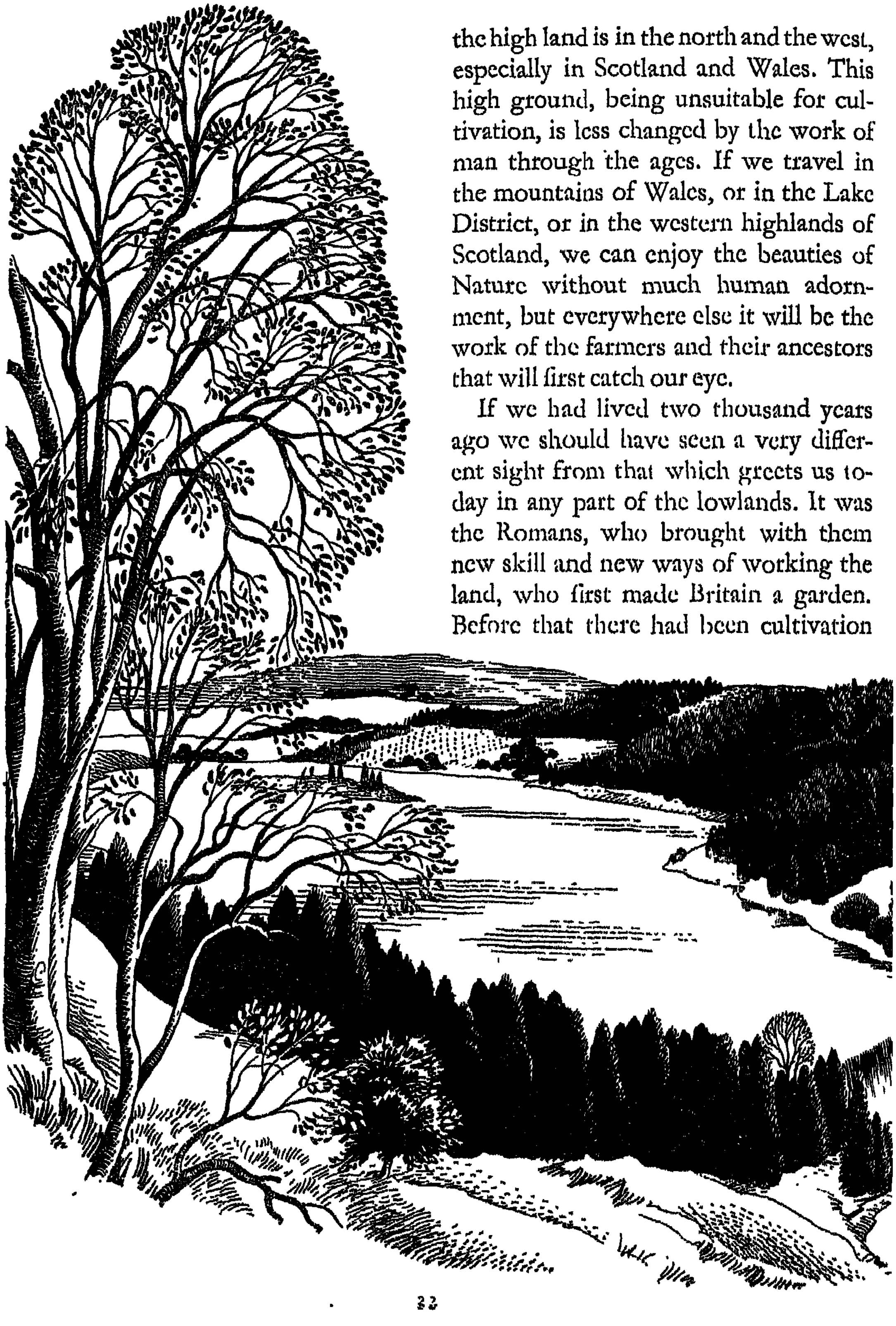
In the Highlands of Scotland, a region renowned for its scenic grandeur, the most beautiful time of the year is late summer when the heather is in bloom. This deep valley in the heart of the Grampians shows a typical tract of moorland. It is a country with its own beauty, but is almost useless for agricultural purposes.

Now that we have explored some of the ways in which Nature moulds our landscapes, we must give a little time to the part played by man in fashioning the scenery. Kent is sometimes spoken of as the Garden of England. In fact, all southern England is a garden on a vast scale. It is as different from what it would be if man, the cultivator, had not worked on it, as one's own garden is from the little plot of waste land that usually goes with a brand-new house. It is not only the crops that the farmers plant, but the hedges or the stone walls

that divide one field from another and give the characteristic English scene the pattern of a chessboard. There are, too, woods and coppices and the hedgerow timber which makes so many country lanes charming. Those are all planted by man, generally to a fixed plan. The old-time forests grew wild, but nowadays forestry is a science which determines what trees will grow best in different places and how they should be planted to give the best timber. That means that the fresh woodlands which are springing up all over the country are designed by the ingenuity of man and are artificial in the strictest sense of that word. Later on we shall see how man the builder has had almost as much effect on the landscape as man the farmer.

If you look at a physical map of the British Isles you will see that most of the high land is in the north and the west, especially in Scotland and Wales. This high ground, being unsuitable for cultivation, is less changed by the work of man through the ages. If we travel in the mountains of Wales, or in the Lake District, or in the western highlands of Scotland, we can enjoy the beauties of Nature without much human adornment, but everywhere else it will be the work of the farmers and their ancestors that will first catch our eye.

If we had lived two thousand years ago we should have seen a very different sight from that which greets us today in any part of the lowlands. It was the Romans, who brought with them new skill and new ways of working the land, who first made Britain a garden. Before that there had been cultivation



only on the downlands, because the valleys were undrained. Vast areas of bog covered in a mass of undergrowth prevented the earliest ancestors from making a living out of it. They had no tools with which to clear the undergrowth and no means of draining the land. But because they had to live, even the prehistoric inhabitants of Britain cultivated strips of land on the southern slopes of the downs, well away from the boggy ground of the valleys, but sheltered from the cold north and east winds.

As the centuries went by, the downs were no longer ploughed. All traces of those earliest farmers of Britain disappeared except for the outline shapes of the ploughed strips. In some places these strips, which run like steps down the slopes of the hill, can still be seen to remind us of this first effort of man to modify the scenery.

Man is striving constantly to harness the resources of Nature. When harnessing water, whether to supply a town or to generate electric power, man often creates rather than spoils beauty. The easiest way to conserve water is to build a dam to hold back the waters of a stream or river so that either the area of an existing lake is increased or a new lake is made. The drawing shows how, in making a reservoir, man can create an artificial lake which, except for the dam at one point, will appear as a natural feature of the countryside.

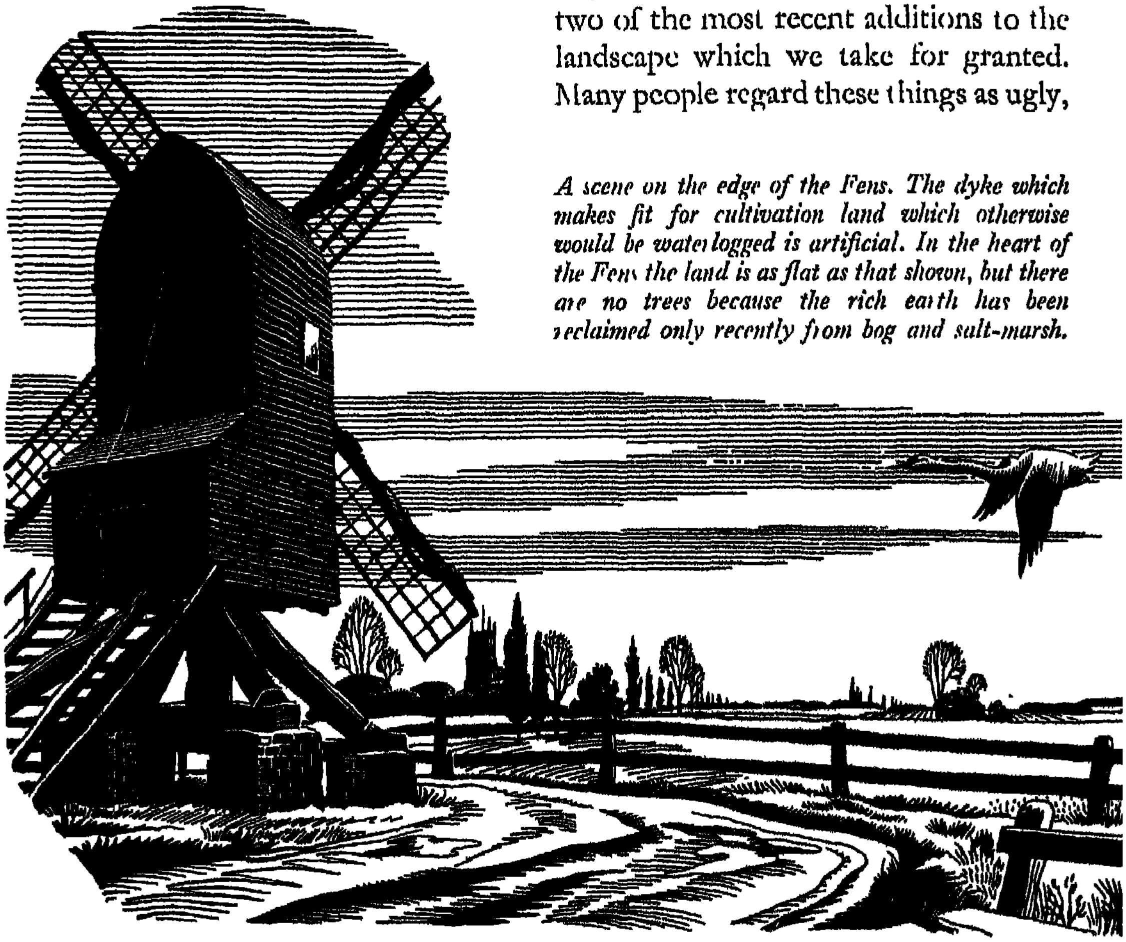
The Roman colonizers who came to Britain as an outpost of empire, in just the same way as British people went out to the new lands of Australia and Canada, transformed what was almost a barren country into a fruitful landscape. The first steps were taken toward making Britain one of the richest farming countries of the world, and today she produces about half the requirements of food and dairy products for forty-five million people. The forests were cleared, much of the land was drained, and new corn crops were introduced. Though the Romans were in Britain for only about four hundred years, their work continued, and the Anglo-Saxons from whose sturdy stock the British people are descended carried on the cultivation of the valleys.

Since then British agriculture has never looked back. Even so, the countryside in the Middle Ages was very different from what it is now. In medieval times Britain was under the Feudal System. One of the features of this system was that the land was not enclosed as we know it today, and this single fact is the key to the whole of the difference.

Imagine the English landscape without its hedges or its walls. Imagine a small village near a riverside grouped about its church and manor farm, with the land ploughed in long, narrow strips near the village, and open grazing ground beyond. That will give some idea of southern England in the twelfth or thirteenth century. Of course, not the whole of the land was cultivated. There were not enough people living in the country to do the work.

The feudal villages were almost as numerous as modern villages, but much smaller, while the scattered farmhouses between villages which are such a feature of rural Britain in the twentieth century were entirely absent, and there were still large areas of uncleared undergrowth and tangled forest land.

Many of the familiar features of the countryside came much later, after the land had been enclosed and the era of great estates had begun. Between then and now all the lovely parks have been laid out and almost all the farmhouses have been built. Roads have taken the place of primitive trackways, and that, too, has made a big difference to the scene. Reservoirs have been built in remote country districts to provide water for the millions who came to live in big towns during the last century. The railways and the lines of electric pylons are two of the most recent additions to the landscape which we take for granted. Many people regard these things as ugly,



A scene on the edge of the Fens. The dyke which makes fit for cultivation land which otherwise would be waterlogged is artificial. In the heart of the Fens the land is as flat as that shown, but there are no trees because the rich earth has been reclaimed only recently from bog and salt-marsh.

but we must remember that when things are familiar to us we accept them as part and parcel of the landscape and often forget that we once thought them unsightly.

Though, by building big industrial towns in open country, mankind has ruined hundreds of square miles of beautiful scenery, man must also have the credit for bringing fresh beauty to the countryside, for bringing the blossom of the fruit-trees to the Weald of Kent and the Vale of Evesham, or for causing green crops to grow in the fields of East Anglia. There are few more beautiful sights than the waving corn in late summer just as it begins to turn colour and gold takes the place of green.

Some landscapes are entirely the product of man's resource and industry, for great tracts of country, particularly in eastern England and in Holland, have been literally recovered from the sea. All that is now called the Fens—an area which includes a large part of Cambridgeshire, Lincolnshire and Norfolk —was once an expanse of marshland. Into it flowed the sluggish rivers from the Midlands—the Ouse and its tributaries—whilst at times of high tide the sea washed over it and when it receded left useless salty mud.

It was a scene of complete desolation, with only a few islands, like the Isle of Ely and the Isle of Ramsey, standing out above the general level. Many efforts were made to retrieve something from the inroads of sea and river alike, but nothing much was achieved until the Dutch engineers, less than two hundred years ago, built sea walls round the Wash and dredged new and deeper channels for the Ouse and the other rivers flowing into the Wash. The New Bedford river, for instance, is an entirely new stream which takes the floodwaters of the older rivers and carries them safely to the sea. Hundreds of miles of dykes or drains were dug to carry surface water away from the land.

Then there was a wonderful transformation. The waters receded and, though the land sank many feet, a fertile area of fields resulted which is one of the richest agricultural areas in Britain. The earth is black, and corn and root crops grow in abundance. Above all, in some districts tulips are cultivated, and the spring glory of their blossom transforms the scene into a miniature Holland. Indeed, the whole of the Fens reminds the traveller of the Dutch scene, with its vast horizons, its featureless but never dull landscapes.

Broadland is another part of eastern England which has been recovered from intractable swamps. Here it was principally a matter of keeping rivers within their banks and of draining the marshy land. Visitors to Yarmouth or Lowestoft will carry back memories of the scores of windmills which, to keep the land from flooding, help to pump the water along the drains or artificial channels.

These areas and others like them along the seaboard of Britain and Europe are still liable to disastrous floods when a combination of high sea tides and rivers in spate threatens the tall earthen embankments. During the Second World War much of the reclaimed land in Holland was flooded deliberately, and so the vast task of reclaiming it had to be begun all over again.

MAN-MADE SCENERY

But for the most part it is true to say that there, as in the English Fens, man has won his battle against Nature and has built for himself new landscapes where before there was only water and desolation. If you ever go to the Fen country and find the beauty of its scenery disappointing, think of it not only as a scene of natural beauty but as the sign or symbol of man's enduring labours and of his successful efforts to produce fresh sources of wealth. Looked at in that light the whole scene takes on fresh interest and a new fascination.

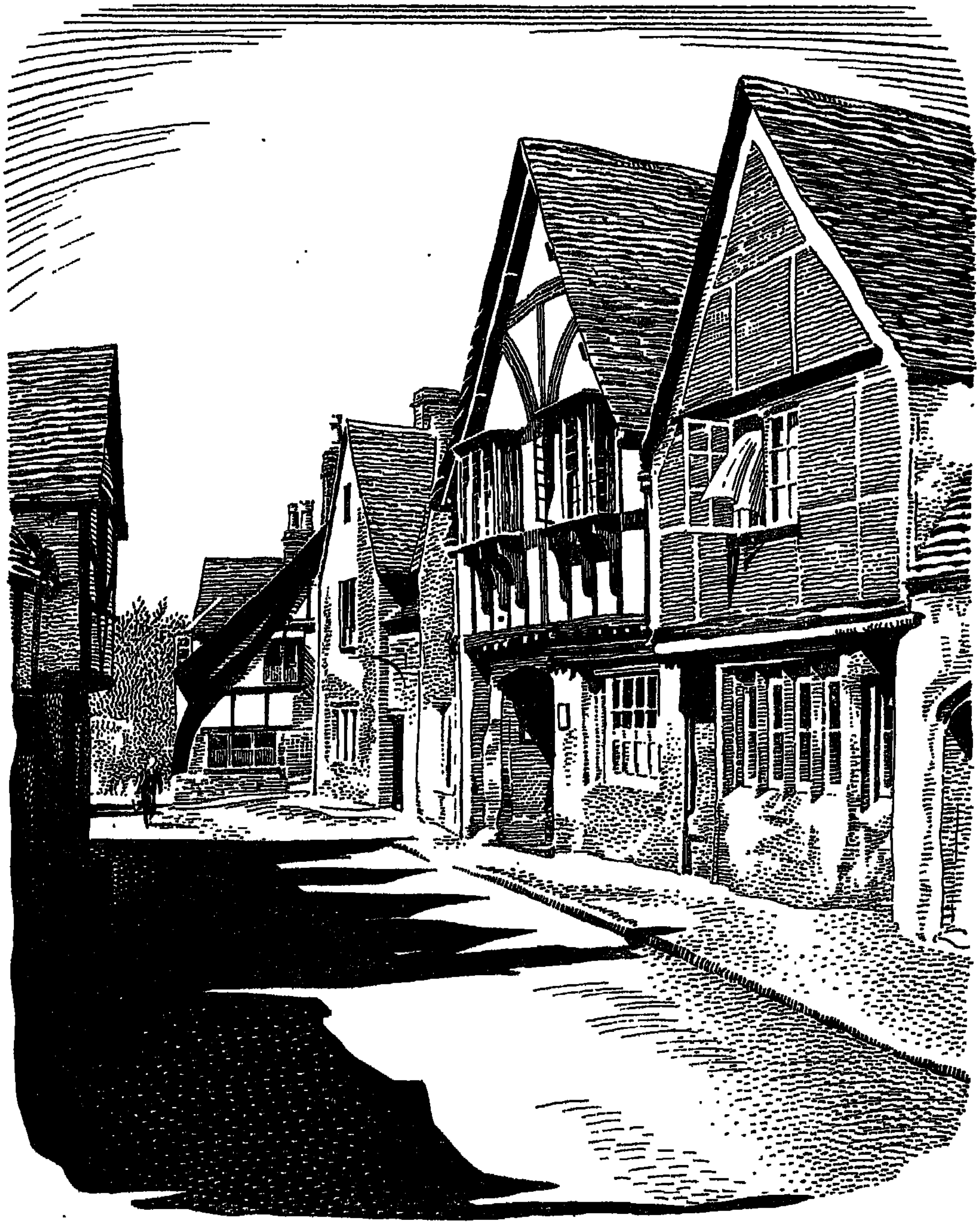
Enough examples have been given to show that the man-made features of the landscape are not always ugly; they often form a part of much of the scenery which is thought most beautiful.

It is only when the handiwork of man strikes a discordant note that we notice it. If you live in the country or make frequent journeys there from town you must have seen the new rows of houses which are being built to take the place of old cottages no longer in good enough repair to be lived in. These new houses are very necessary because it is not only a matter of replacing buildings that are worn out but of building homes for the thousands of new workers who are needed to make the land produce more and more food for the people.

SPOILING THE LANDSCAPE

Necessary things are unfortunately not always beautiful. Many of the new houses in the country spoil the charm of quiet villages and take away from the beauty of well-loved landscapes. But that is not always because they are ugly in themselves (in fact, many are well designed by famous architects). It is because of their very newness, the glaring new colours of red bricks and tiles which prevent them toning with the more subdued colouring of the country scene. When these houses are a hundred years old people who see them for the first time will probably accept them as part of the scene—if they notice them at all.

If you find this difficult to believe, see if you can spot any really old cottages or farms which seem to you to spoil the beauties of Nature. You will see that all the ancient villages are pretty and that the beauty of many fine landscapes is enhanced by some old farmhouse or manor-house nestling in a tree-fringed hollow. There is something mellow



The village of Lacock, now the property of the National Trust, has been restored so carefully that the buildings retain their character and show a variety of styles of architecture, including both half-timbered and stone-built houses, dating from the seventeenth century or earlier.

This cottage is in Cheshire, where there are many like it because it is a part of Britain in which there once were vast forests which provided timber for the builders. Before bricks came into general use man had to utilise whatever materials he could find locally.

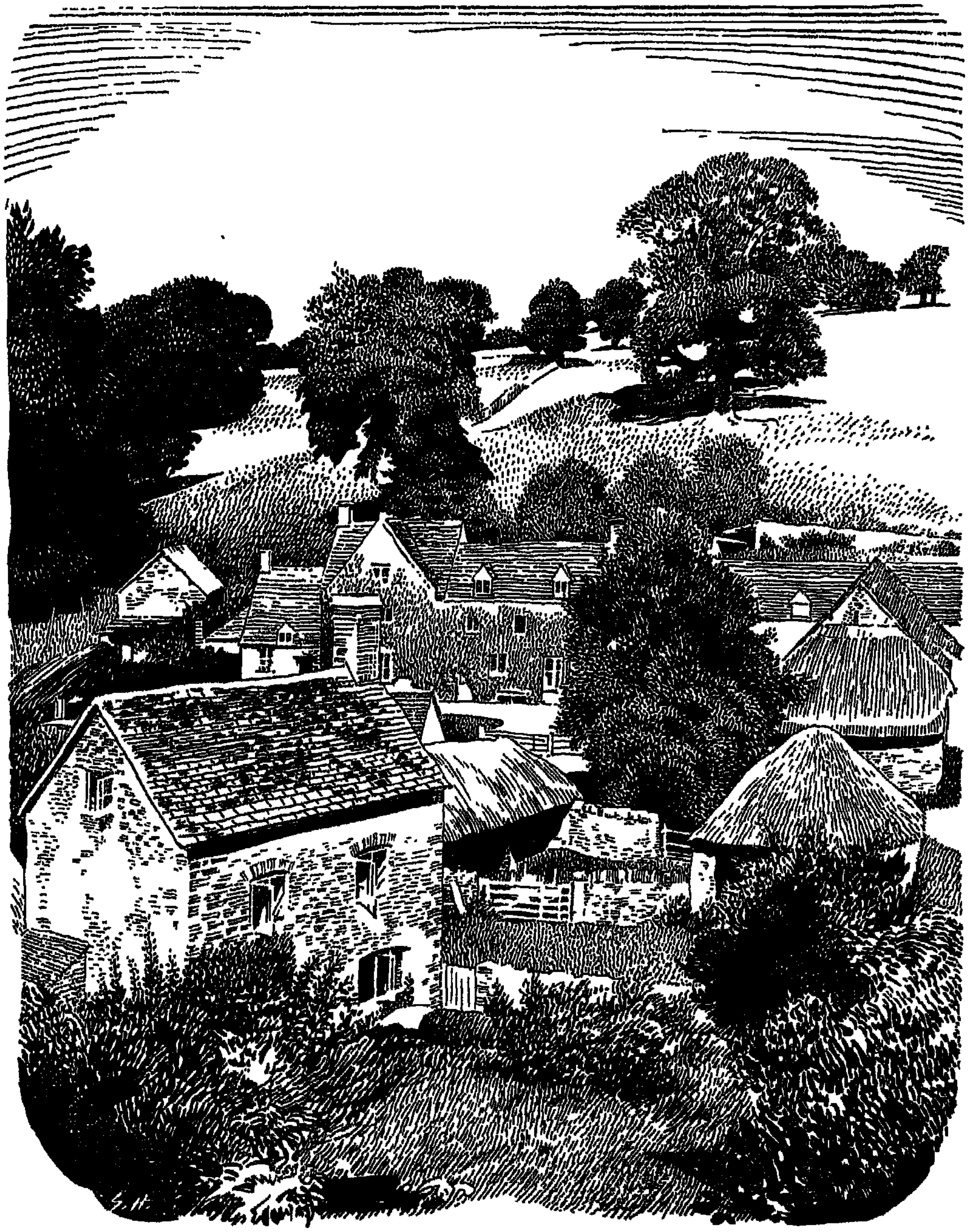
about an old building which makes quite ordinary houses attractive, even though the inside is not nearly as convenient as a modern house.

So it is true to say that Nature is at work all the time transforming what man has built into something more beautiful, and assimilating things that are new or ugly into her own scheme of beauty. There is another difference, too, between most new buildings in the countryside and the old ones. The new houses are usually built from bricks and mortar with roofs of tile. But the older houses in the country are often built of other materials, including timber and stone. This makes all the difference to the effect they have on the landscape. If locally quarried stone is used, the colour of the building, whether it is church, mansion or the humblest cottage, never clashes with the prevailing colour of the surrounding fields. The modern brick industry allows more houses to be built more cheaply, but it has had the effect of robbing many a pleasant landscape of a beauty which it need not have lost if local stone had been used instead.

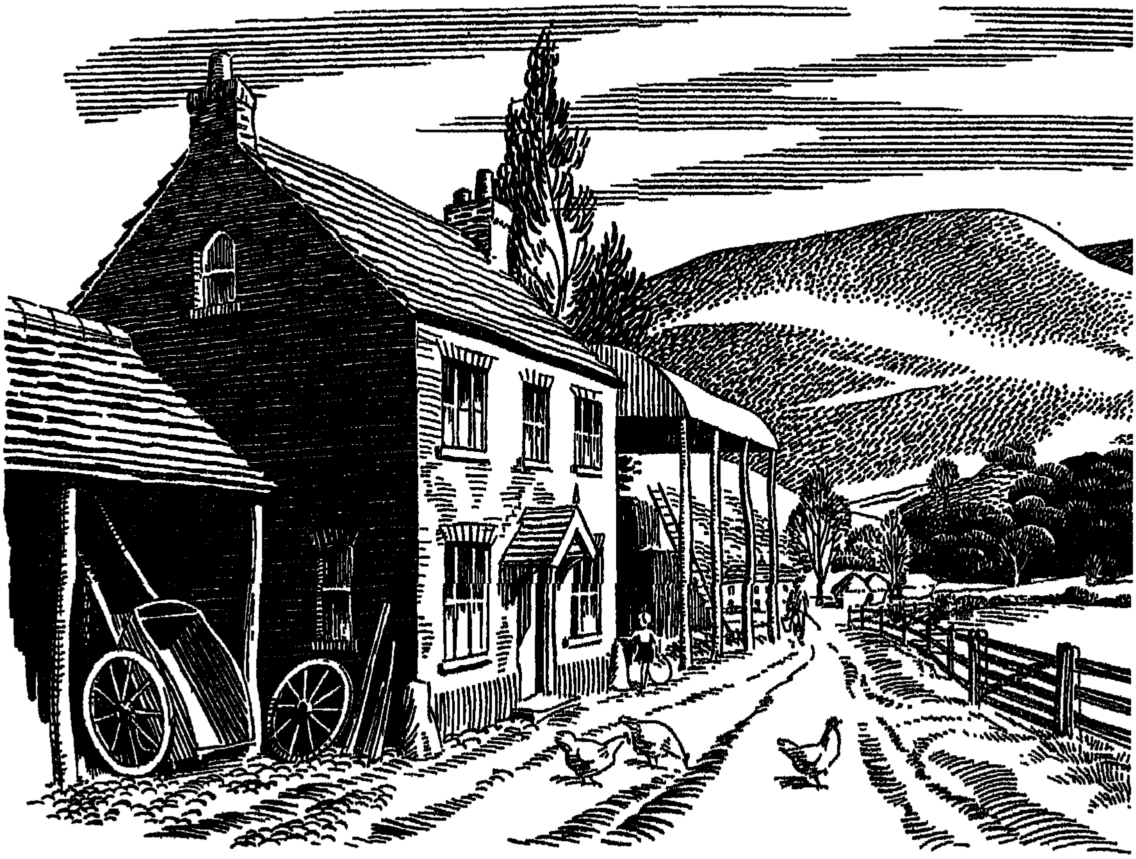
In the Cotswold Hills building stone is so plentiful and so easy to quarry that it is still being used to build new dwellings. This Cotswold stone is a charming grey limestone, and it weathers so quickly that within a few years of being built new houses look as attractive as old ones. The result is that towns and villages in the Cotswold country are uniformly gracious to look at and tone perfectly with the natural beauty of the countryside.

Other parts of Britain in which building stone is used to good effect include Devonshire, where the deep red of the local sandstone is wonderfully attractive and here again tones with the reddish hue of the ploughed fields. In parts of east Scotland there are whole villages and towns and one big city built of granite. Aberdeen is one of the loveliest cities in the world, and it owes this in no small measure to the beauty of its granite buildings.

In the Pennine country of Derbyshire, Yorkshire and Lancashire the natural grey stone is used. This has a much colder and more sombre appear-



Cotswold stone has been used for building ever since the early Middle Ages. The soft grey colour harmonizes beautifully with the countryside and the stone has great durability. The mill and manor-house shown here look much as they did when first built, perhaps four hundred years ago, and they are today, as they were then, integral parts of the village economy.



The small farmhouse is characteristic of the mountain country of the Pennines and the Lake District. Mixed farming is carried on: there is rough pasture for sheep on the high ground, on the home pastures a small herd of cattle grazes and there is a narrow strip of cultivated land.

ance than the grey stone of the Cotswolds. But the countryside is barer and darker. This darker stone is just as appropriate to the austere beauty of the Pennine country as are the warm tints of the Cotswold stone to the more kindly landscapes of the south.

When the medieval builders had no nearby source of stone they had to use any other materials that they could lay their hands upon. In north Norfolk there are a number of attractive villages, like Cley and Blakeney, where many of the cottages are built of cobblestones. In the downland country of southern England flints are easily obtained from the chalk, so we shall find in Surrey and Sussex, in Hampshire and Wiltshire, that a number of old cottages and a few churches are mainly flint-built.

But when there was no stone, timber was the obvious alternative in well-wooded country. So the half-timbered house is a fascinating feature of most country scenes in the Weald of Kent, in some of the Midland counties, and in the counties that border Wales, especially Cheshire and Shropshire. On your

country journeys you will find that different districts evolved quite different designs in timber-built houses. For instance, you could not possibly mistake a typical Cheshire farmhouse for a Kentish yeoman's house. The elaborate and ornate timber designs of the former make them quite unlike anything else in Britain.

This, then, is the pattern of the rural scene in Britain, as it is in every country of the world. It is a series of landscapes which Nature has moulded from the rocks forming the crust of the earth and which man has clothed with garments of various colours as he ploughs and sows and harvests. We have seen how the nature of the soil and the effects of climate dictate what use the farmer can make of the land, and how through the ages building has sometimes increased the beauty of the landscape and sometimes destroyed it. Finally we have learned enough to judge for ourselves how the work of man and of Nature is so closely interwoven in the country pattern that it is often hard to distinguish one from the other.

Birds and their nests

BIRDS HAVE always interested mankind. Their songs have inspired poets, and for thousands of years their powers of flight filled men with the desire to copy them. Few living creatures are more mobile or more widespread over the surface of the earth. At the same time few are more varied in form, colouring, and behaviour.

Birds are, indeed, man's greatest allies in a war which he is always fighting and probably always will have to fight—the war against the insect kingdom.

The bird population of Britain is of particular interest. Although it is true that there are not many birds which possess that brilliance of colour so often seen among tropical birds, the kingfisher would certainly stand high in that respect among the birds of the whole world. There are in Britain, however, some of the most beautiful songsters in the world, and few countries can boast of a greater variety of bird life.

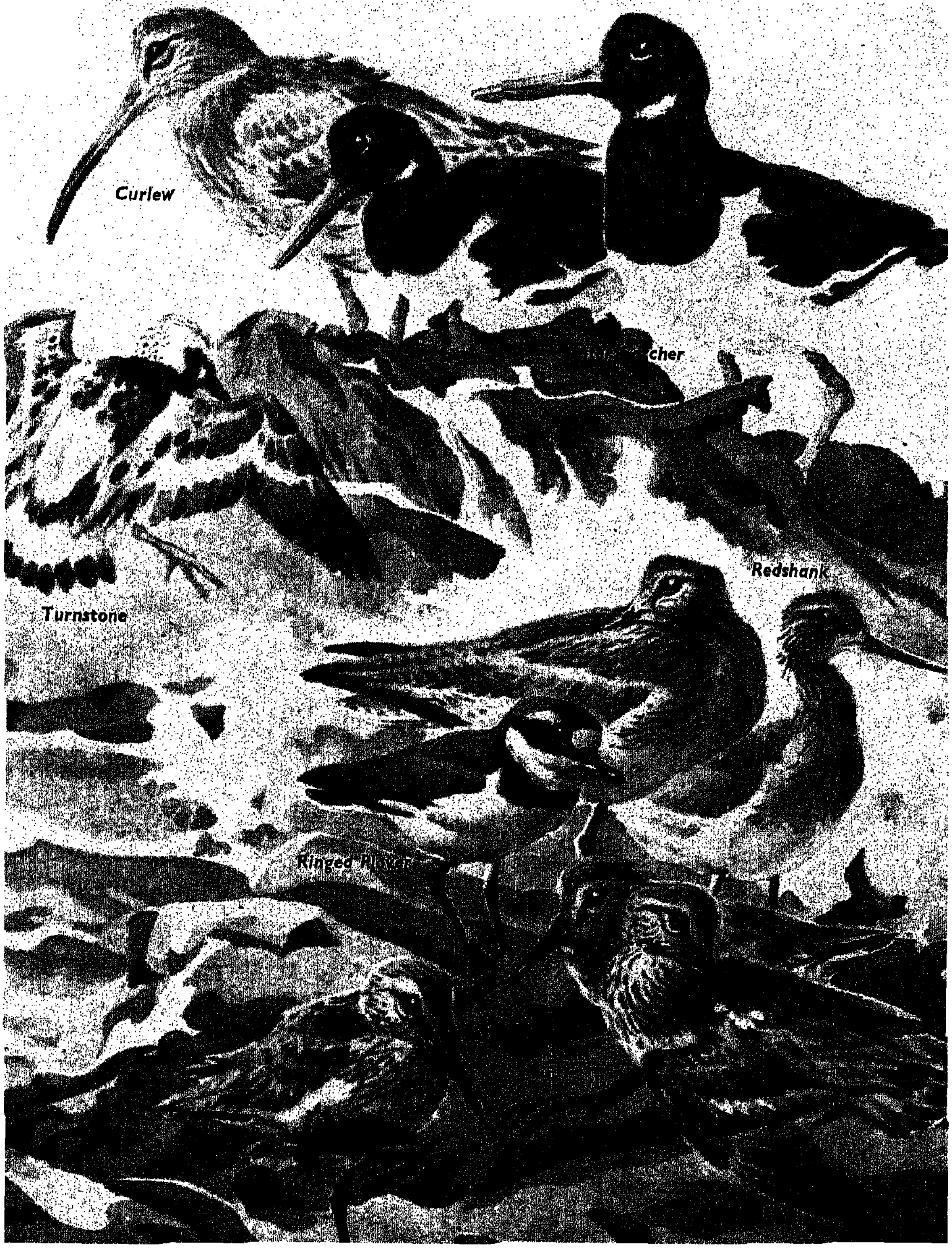
There are just over five hundred species of bird on the British list, but of those only about one hundred and ninety nest in Britain. The rest are visitors, some of which stay for some months every year, whilst others pass through the country only on migration, and a number are extremely rare visitors which have found their way there by accident.

To get to know even a little about birds one needs to watch them, to notice how they go about life, how they feed and what they eat, their nesting habits, and the places in which they prefer to live; for birds, just as human beings, have their likes and dislikes. Some must live near the sea, others in open country. Some prefer woodlands, whilst others are found only on open moorlands or in the wilder mountain country.

Several species attach themselves more or less closely to man and depend on man's activities for a great deal of the food they eat, whilst others seem to avoid human beings as much as possible.

Let us see, then, some of the things that distinguish birds from all other creatures. If you were asked what it is that birds possess and which no other creatures have, you might well have to think for quite a time. Yet it is the very thing seen immediately you look at a bird—namely, feathers. Feathers are a most interesting study in themselves, and provide a wonderful example of how Nature will develop, from quite

BIRDS THAT LIVE BY THE SEASHORE



Coal Tit
Coal Tit
Great Tit
Blue Tit
Chaffinch

simple beginnings, the most marvellous results.

If anyone who has made a study of the subject were asked how the living creatures of the world have developed, he would say that birds have evolved from reptiles. At first sight that does not seem at all easy to believe, because those creatures, with their soft, filmy covering of feathers, are so different from a scale-covered reptile. Yet it is a fact that feathers are nothing more than highly developed scales. Moreover, every bird still carries the mark of its reptile ancestors in the scales to be seen on its feet and in the very shape of its feet; but all the same it is a long way from a lizard to a bird, and Nature has performed many miracles along that line of evolution.

Another interesting thing about birds is their blood temperature. They have blood which is much warmer than that of any other creature. This is due to a great many causes, and means that they have a tremendous amount of energy which can be used quickly and suddenly.

BIRDS HAVE BIG APPETITES

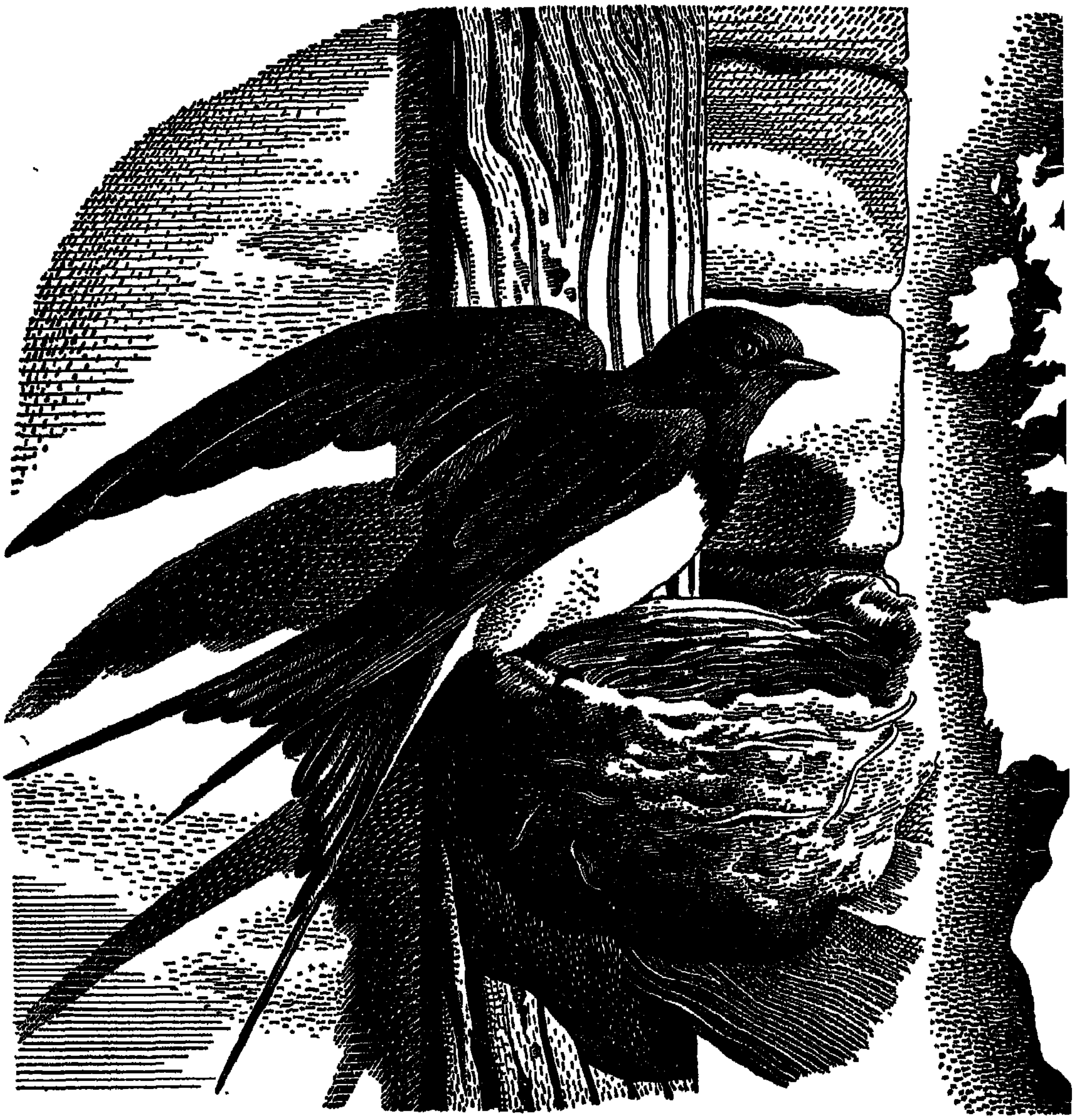
You will have noticed that a bird is extremely quick—it is almost "explosively" active. That brings us to another important thing. To have so much energy and such high blood temperature a bird requires a lot of fuel in the form of food and, as a result, birds have big appetites. Some of them eat more than their own weight of food every day. Indeed, young birds in the nest often eat two to three times their own weight of food every day. That, by the way, is one reason why certain types of bird are always busy searching for food.

A great naturalist, the late Thomas Coward, once tried an experiment on a robin. Mr. Coward and a friend went out into the garden and began digging worms to feed a very tame robin which lived in their garden. Before they gave each worm to that robin they measured it. They worked hard digging worms, and by the time they were tired they found they had fed that robin with *fourteen feet* of earthworm. The robin did not seem at all troubled, and indeed appeared to be rather indignant when Coward and his friend stopped digging, but it is almost impossible to satisfy the appetite of a robin.

WAR ON INSECTS

That is an illustration of the remarkable powers of digestion and of the amount of food even a tiny bird can deal with, and it explains their remarkable energy on the one hand and shows, on the other, their immense value to man. Think of the millions of birds to be seen at all seasons of the year and of the countless millions of insects and grubs they eat in a year. Then ask what conditions would be like for the farmer and the gardener if all those grubs and insects lived on and could breed and increase. The fact is that it would be difficult to grow any food at all and disease would be far more widespread than it is. In that way, then, birds have a value for mankind which is so great that it cannot be estimated.

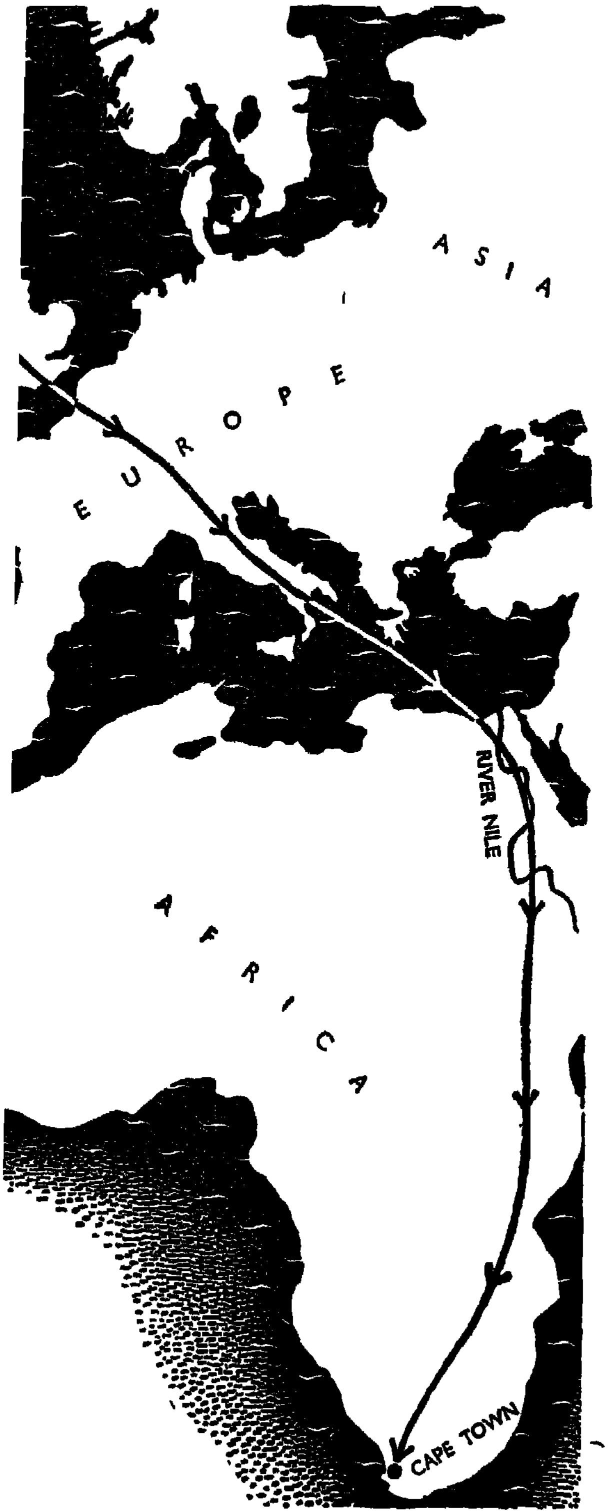
One of the most interesting features about bird life is migration. With per-



Twice a year swallows make the long journey between Britain and South Africa. The route over which they fly is shown on the opposite page.

haps only two exceptions, all British birds migrate to some extent. The robin is the most stay-at-home of all, but the only bird which never migrates is the red grouse of the moors, and it, incidentally, is the only truly British bird. It is the only bird not to be found as a native species in any other part of the world. It has been introduced into other countries from time to time, but its true home is Great Britain, and it does not really belong to any other country.

Migration is a big subject. It really means that creatures which indulge in



the habit have two homes, which the use at different seasons of the year. They travel to and fro between those homes as the seasons change. The journeys they make vary a great deal. To take a few instances: the chiff-chaff and the willow-warbler spend the winter round the Mediterranean, and visit the British Isles in March to raise their families. They leave in the autumn and go off to the south of France, Spain, or North Africa. Thus they never have to face the difficulties of a severe winter.

Swallows do the same, but travel a great deal farther when they leave. The swallows which are seen flashing round houses and under trees in late spring and throughout the summer leave Britain in the autumn and cross the Channel. They travel south of the Alps and down the length of Italy, then across the Mediterranean to the Nile Delta. They follow the Nile through the Sudan and on and on, past Abyssinia, Tanganyika, and through the heart of the African continent, until they reach South Africa, and the very birds to be found round an English farm in summer may be seen along the sides of Table Mountain a little later in the year. The most remarkable thing is that the following spring they make the return journey, and very often go back to the same barn, and nest on the same beam, on the English farm where they nested the previous year. That is probably one of the most wonderful facts of all.

Swallows, however, do not make the longest journeys. There is one bird—the Arctic tern—which visits England for nesting in June and after leaving

Unlike the song-thrush, the missel-thrush does not build its nest in hedges, shrubs, or bushes, but in a fork in the branches fairly high up in a tree.

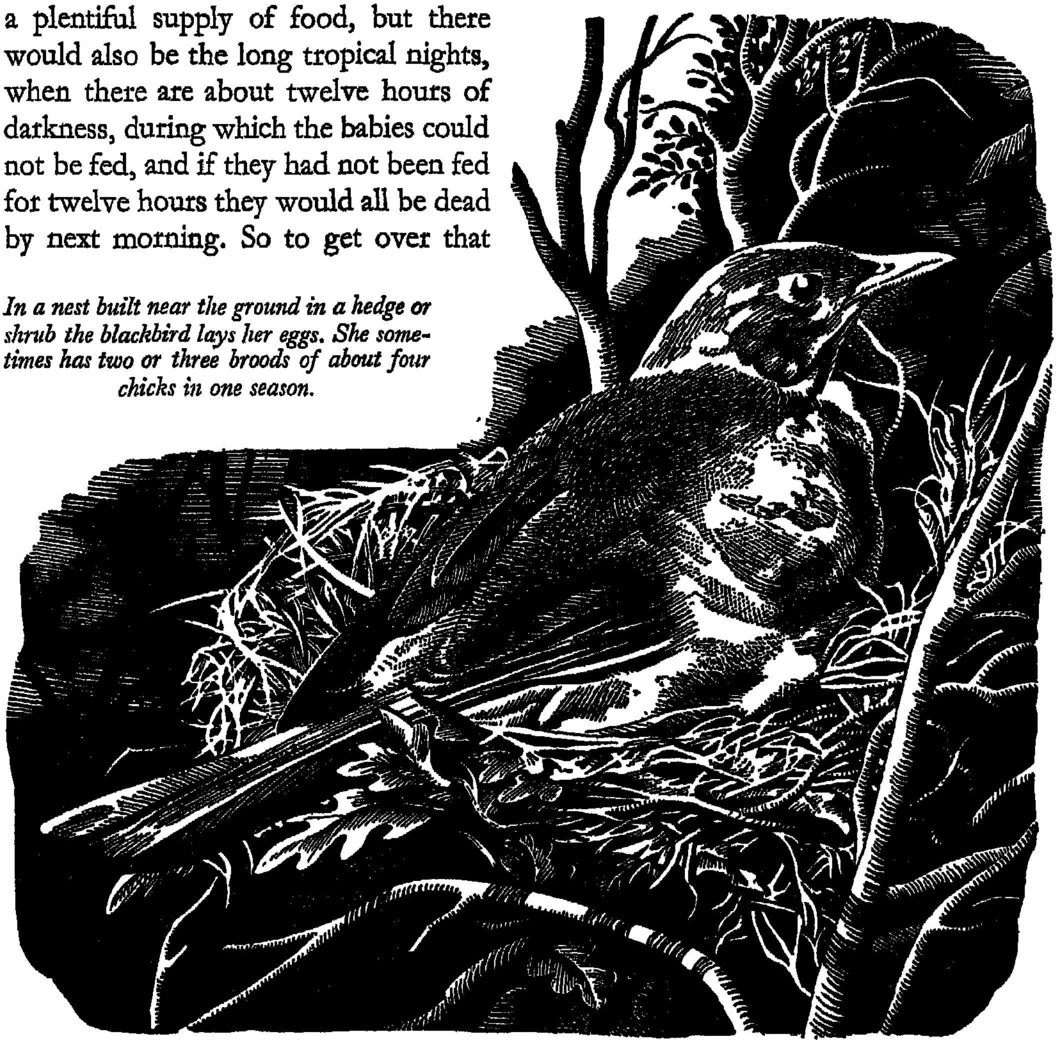
flies right across the world, and has been seen as far south as the Weddell Sea in the Antarctic. Each year these birds travel scores of thousands of miles, and spend the whole of their lives without knowing what real winter is.

Why do birds migrate? It is a hazardous undertaking, and thousands are killed on migration every year. Yet, because it is so dangerous, one is all the more puzzled by it. It is partly on account of food supply, because many birds feed on certain things which can be obtained only at certain seasons, but that does not answer all the questions. Let us have another look at swallows.

Swallows feed exclusively on insects, and there are always plenty in Africa all the year round. It cannot therefore be said that they leave Africa in spring because insects are scarce, so there must be another reason for it. Probably it is something like this. Young swallows have very rapid digestions and need large quantities of food. They cannot live very long without food and, indeed, it is well known that they will die of sheer starvation if kept without food for even as much as eight hours.

Now, that means that swallows simply cannot rear their young in countries near the Equator. There would be a plentiful supply of food, but there would also be the long tropical nights, when there are about twelve hours of darkness, during which the babies could not be fed, and if they had not been fed for twelve hours they would all be dead by next morning. So to get over that difficulty swallows have to go to a country where in summer the days are long and the nights are short. In an English summer they find those conditions, and can often feed their young for eighteen hours or even more out of the twenty-four, so that the young are never without food for more than five or six hours at the most.

That is but one instance, and it applies only to that particular species of



In a nest built near the ground in a hedge or shrub the blackbird lays her eggs. She sometimes has two or three broods of about four chicks in one season.

swallow to be found in Britain, but it will serve to show that this business of migration, which is so important among birds, is indeed as much part of their lives—and as necessary to their lives—as are many of the things human beings are compelled to do. It is not done just for fun or just in order to travel around and see as much of the world as possible. Birds have to do it whether they like it and whether it is dangerous or not.

With all that in mind, then, British birds can be divided up into certain groupings and a closer look taken at them around the countryside. They fall into four main groups: residents, summer visitors, winter visitors, and passing migrants. The odd and casual visitors can be put into the last group.

To the frequently asked question: "How does one begin to get to know birds?" there is really only one answer. One can, of course, get to know a lot *about* birds by reading books and listening to people who talk about them, but to get to *know* them you have to watch them—and that is a most fascinating pastime. One never gets tired of it, because there is always something new to learn and see—always something which has escaped notice before, and quite often there may be something which no one else has noticed either. That is why it is so interesting, for there is a pretty

Among the grasses, beside ponds and streams, live reed-buntings. The nest, which is made of grass and hair, is hidden among the reeds, and the eggs are brown with black patches. The nestlings are helpless, and if the nest is approached, the parent birds instinctively pretend to be injured, in order to distract attention from their young. Both the cock, shown ABOVE, *and the hen, who is brown without a dark cap, gather food for their young. Reed-buntings are common resident British birds and seldom move far from the territory in which they are reared.*

Whitethroats are not resident in Britain, but each year these birds arrive there in April and build their nests in hedges or among nettle beds in waste places. Both the cock and the hen work together in building the nest and, when the eggs are laid and hatched, help each other to rear the young. Whitethroats are to be found in almost any part of Britain until September, when the parent birds depart for warmer countries, followed later by the young birds.

good chance of being a discoverer, and everyone, surely, likes to be that.

To discover new facts about birds does not mean, either, that one has to go off to some remote part to observe some rare bird, like, say, the golden eagle. As a matter of fact, a great deal more is known already about the golden eagle than about many of the common birds, such as thrushes and hedge-sparrows and starlings. Everybody likes to go in for rarities, but very few people trouble to study the commoner birds, so there is a great deal which is not known about many of the birds to be seen every day around houses and in fields and hedgerows. Many things about their habits and why they do this or that in the way they do it can be discovered by anybody who is prepared to make a real study of one particular species, to watch and observe carefully, and make detailed notes. At the end of a single year it is really surprising how much can be discovered which is not to be found in any book about birds.

One needs to specialize, of course, but first comes the business of learning to recognize as many birds as possible. That is where the game begins to be interesting, dealing as one is with wild things which are extremely quick, wary and often intelligent to a degree that surprises many people. Birds are suspicious, and it is usually difficult to get near enough to observe them very closely, and so it is necessary to take steps which will overcome those difficulties.

A pair of field-glasses makes it possible to watch closely whilst remaining at a distance, and so these are things every bird student goes in for as soon as he can afford them or can persuade someone else to buy them for him. One can then really examine a live bird as it sits perched or stands singing on a branch, see its real colouring and markings and the ways in which it moves about. Then there is also the recognition

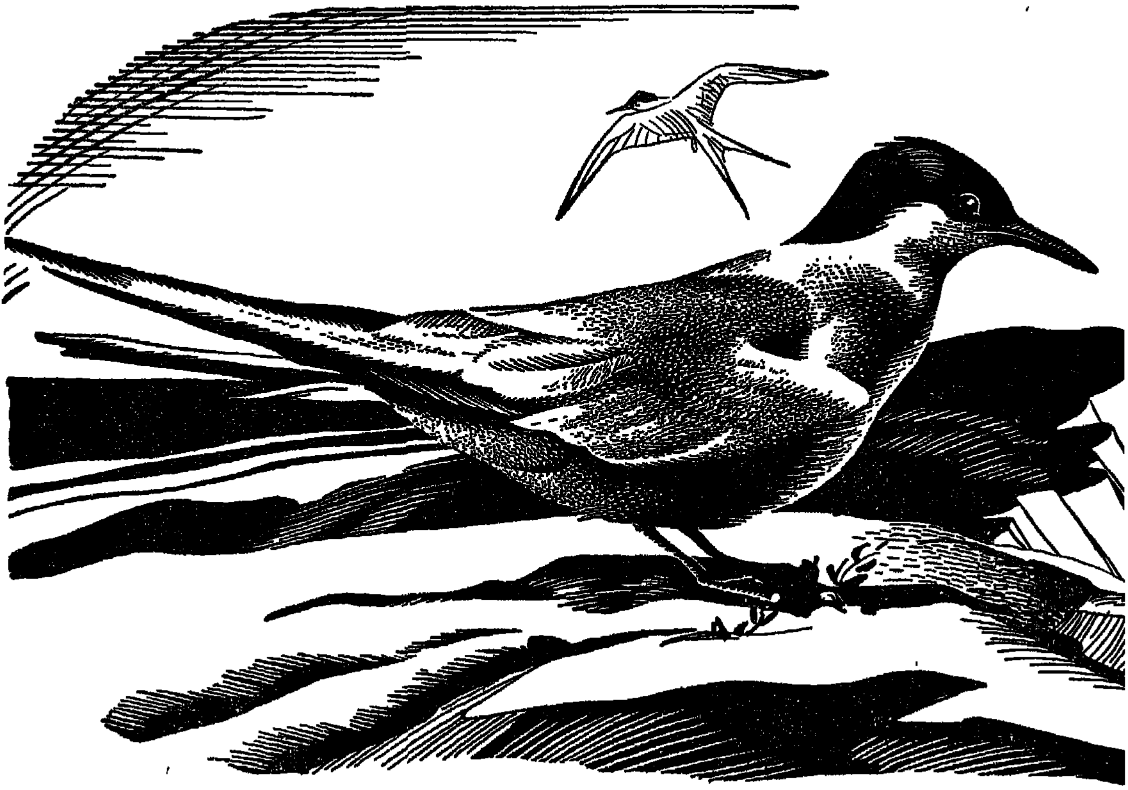
Robins are among the easiest birds to tame because they are usually quite fearless. They are good parents, both cock and hen birds working untiringly to feed their young on worms and insects of all kinds.

The goldfinch has a red head and neck and a golden streak on each wing. It feeds on insects and the seeds of many kinds of weed, especially those of thistles, upon which it is able to perch unharmed by the prickles.

of bird-calls and songs. Quite often the first thing which tells you that a certain bird is around is not that you see it, but that you hear it call, and so can recognize it. That comes only with practice and observation, but it is possible to learn a great many bird-calls, and often to learn them so well that it becomes possible to say what the bird is doing even if you cannot see it. The feeding call, the alarm note, the recognition note, the song—all those things can be learnt only by observation and practice, but when you are out in the country they are immensely interesting and valuable, and can make a walk more interesting.

Let us take a look, then, at a few birds one can see fairly frequently, and try to discover ways and means of getting to know them better. To begin with, there is the business of sight. Of practically all creatures, birds have the most remarkable powers of vision. If you are in doubt, watch a thrush or a blackbird for a little while. See him first perched on a branch perhaps fifteen or twenty feet above the ground. Suddenly he drops to the ground and begins pulling a worm up from under the grass. You have probably seen that many times. You have also walked across a lawn or field many times yourself, but how many times have you seen the tip of a worm sticking out of its hole in the grass? You will, of course, have seen worms on the surface, but not when they are merely putting the tip of their heads up through the grass. You have walked past scores which were doing that, and have been only four or five feet above them, yet you never saw one. But a blackbird will see them as much as forty feet away!

Again, watch that lovely little thing, the goldcrest, the smallest British bird.

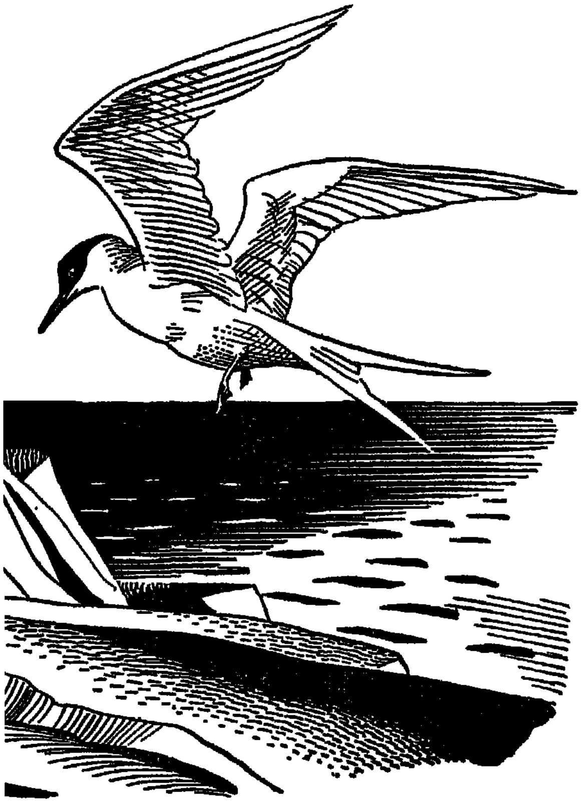


Terns fly to Britain in the late spring and lay their eggs on the rocky shores. These birds hover for long periods over the sea in wait for any small fish that swim near the surface. Though little more than a foot from beak to tail, they bravely attack even large animals that try to molest their young.

It is about half the size of a wren—a little olive-brown bird with a brilliant golden streak on top of its head. This creature feeds entirely on minute insects, often smaller than the head of a pin. He picks them out from crannies and cracks in the bark of trees, from moss- and lichen-covered walls. All day long his beady little eyes are seeking microscopic morsels of insect life. His powers of vision are almost incredible, but they have limitations.

If you are fortunate enough to see a goldcrest seeking food you will find that by moving slowly you can get quite close to him, and may even be able to stand within a yard or so and watch him probing among moss and leaves. If you stand perfectly still, he is so short-sighted he will not see you, and may even perch on your shoulder—not because he is tame, but because if you keep perfectly still he will not even know you are alive. You are so very much bigger than most of the things he searches for that you are actually too big for him to see and appreciate as something alive and possibly dangerous.

Another bird which you can often approach like that is the tree-creeper.



He, too, spends his time searching bark crannies and is too short-sighted to see things as big as a human being, though he will sense any sudden movement and be off in a flash. In bird-watching, then, learn to move carefully and to "freeze," or to stand perfectly still even when a fly does happen to alight on your nose! Better to bear with the fly for a moment than miss the opportunity of seeing something you may never see again.

Birds have quick ears, but, again, if you know something of their habits it enables you to overcome difficulties. Some years ago one observer went out to some high rocks off the coast. These are dangerous to shipping, and there is a powerful lighthouse there with a very loud foghorn, which can be heard thirty miles away. Those rocks are covered in summer with nesting terns—scores of thousands of common Arctic and roseate terns nest there. Their nests are so close together that you need to watch every step you take, otherwise you step on eggs or young birds. When the parent birds are sitting they are almost shoulder to shoulder, and it looks just as though someone had thrown a large white sheet over the greater part of the surface.

This observer had been on the main island for some hours photographing and taking notes of eggs and young birds when the lighthouse keeper came along and advised him to be thinking about leaving, as a fog was coming up and, as he had only a small sailing boat, he might get into difficulties with the seven-mile sail back to the mainland. Further, the lighthouse keeper said he was going to start up the fog signal and wanted to warn those near to it. Well, that was very kind of him; but what was a foghorn? When it started, however, even the solid rocks appeared to shake. Every minute and a half it went off, and each time it seemed worse than before, like the roar of a thousand lions, deep pitched, and ending with a dreadful "gru-ump."

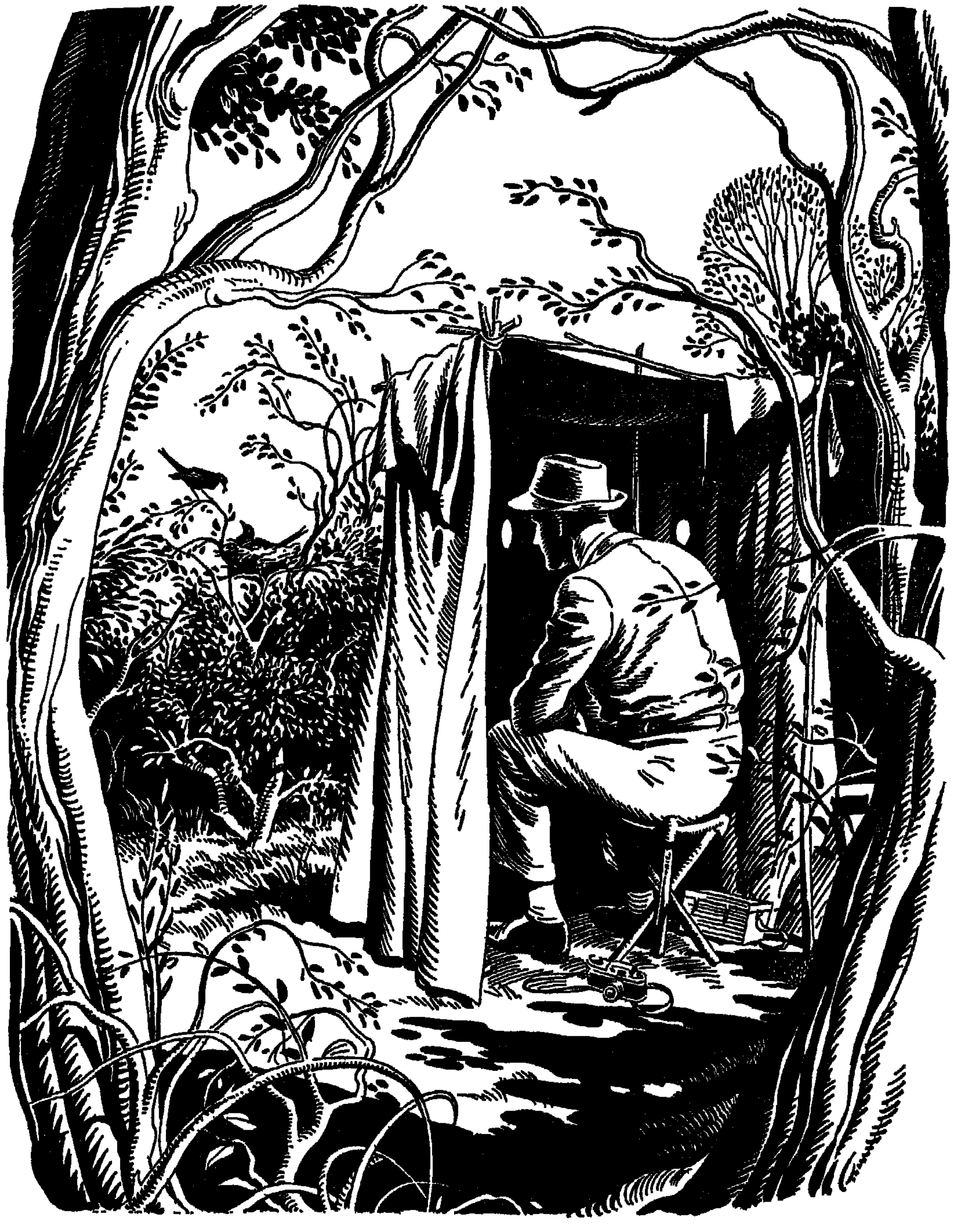
Now, what about the terns? By all the rules, one would have expected them to fly away to sea terrified, but they did not. There, within a matter of five feet, on every side, were hundreds and hundreds sitting on their eggs or brooding their young. There were scores of young birds within easy reach, some just out of the egg, others a week or a fortnight old. "Gr-r-rump!" went the foghorn, sixty yards away. They never even blinked; never moved or took the slightest notice of that tremendous sound. All the other terns were the same. None of them took the slightest notice. Now, that was strange, and it could scarcely have been that they had got used to it, because there had been no fog for several weeks. This meant that not one of the birds on those islands could ever have heard the foghorn, for they had not been there long and, in any event, hundreds of the young birds were only a few days old.

The fact is that terns cannot hear the deep, low note of a foghorn at all. They were probably quite unaware that it was going off; the note was too low-pitched for them to be conscious of it.

The wren is one of the smallest British birds; it is easy to recognize because of its brown feathers and upturned tail.

If you want to get on really close terms with birds nothing beats a hiding-tent. It need not be elaborate. Just any dark-coloured material which can be erected on sticks and enables you to get inside and sit comfortably. Using such a thing, however, needs a little care. If you put it where other people can see it they will wonder what it is and most probably will come along and look and —well, that will defeat your object, and is one reason why the material should be rather dark in colour, so that it is not so easily seen by people. The birds do not worry what colour it is, anyway. Put up your tent some distance from the place where you actually want it to be, and leave it for a day. Then move it a little nearer and leave it again. By about the fourth day the birds will be so used to the thing that they will just ignore it, but if you set it up immediately in the place you want to use it you may cause the birds to desert the nest they are either building or using, so take care not to alarm them, or you will learn nothing at all.

Once your tent is ready you can begin to use it, but again there are one or two things to bear in mind. Never go alone and get into the tent. The birds see you come, and wait for you to go away again, and they will go on waiting until you do go, which not only means that you see nothing, but may very well cause eggs to become chilled, or young birds to be starved, or a nest to be left unfinished. Take someone else with you



It is not always possible to take close-up photographs of birds without frightening them. In this picture a bird-watcher is shown in a simple type of shelter known as a "hide." Birds quickly become accustomed to a "hide", and can easily be watched and photographed at close quarters.

The lapwing nests on the ground and lays eggs in exposed places such as open fields. It does a great deal of good as it feeds on harmful insects in the soil.

to the spot. Get into the tent, then send your friend away, and the birds will be back again in a few minutes. They are not at all good at mathematics, and "one from two leaves one somewhere about" means nothing to them.

From such a tent you can watch at close range everything that goes on. Watch the way in which the wonderful nest is woven—that is something few people have seen. Or you may see the cock bird come along with a caterpillar or some other tit-bit and feed the hen as she sits on her eggs. He will feed her and make quite a fuss of her and then, quite often, begin to sing to her—not the loud song which you hear him shouting from a tree or telegraph pole, but a quiet little whisper of a song which can only be heard a few feet away. That is what we call the undersong, and is only for the ears of his lady. Very few human beings ever hear those songs which are the true love-songs of birds. Poets even have not written about them, maybe because no poet ever thought of using a hiding-tent and trying to find out things about the home-life of birds.

Many of the common birds of Britain have been given names which, if you think about them, are odd. Of course, the same bird very often has different names in different parts of the country. The green plover, for instance, is also called the lapwing or the peewit, and the hedge-sparrow is called either the hedge-accentor, the dunnock or the nettle-creeper. The latter name, by the way, he shares with the whitethroat. But many names are widespread and everybody knows them. To begin with, quite a lot of birds have what one might call Christian names, like tom-tit, jenny-wren, robin-redbreast, jack-daw, magpie, and phillip-sparrow.

The habits of the hedge-sparrow differ greatly from those of the house-sparrow, to which it is only distantly related. By destroying caterpillars, and weed seeds during the winter, the hedge-sparrow benefits both the farmer and the gardener.

You will notice that all these are familiar stay-at-home birds and are common round the homes of Britain. They are there all the year round, and although there is a general movement southward in autumn, and the thrushes and blackbirds in the gardens in summer may go off to France, others from the north fly to Britain, and so no one notices that there has been much of a change. That is what may be called a "masked" migration, and it is not always easy to discover just what proportion of change in the bird population takes place that way. True, you can check occasionally, when by some means you get to know certain individual birds. You may think that is difficult, and that all song-thrushes, for instance, and all starlings are so alike that it is not possible to pick out individuals; but that is not the case.

ALBINISM IN BIRDS

Again, it is best to start with easy subjects, and perhaps the simplest of all is the blackbird. If you take notice you will soon find a blackbird which differs from all his brothers in some way, usually because he has some white feathers. For some strange reason blackbirds have a tendency to what we call albinism—that is, to grow feathers which, instead of being black, are pure white. White blackbirds with pink eyes are frequently seen, but far more commonly one sees marked ones. They have been known to nest in the same garden year after year. A marked blackbird is fairly common, and if you happen to spot one you should make a habit of watching out for him, as you will be able to gain quite a lot of extra information simply because you know that particular bird. You will be able to work out the range of his territory and discover a number of things about the way he works and organizes his day, because you can pick him out from his fellows and concentrate attention on him. A certain guillemot has been known to return every year for eighteen years to the same place on the same ledge to lay her egg.

Now a little more about the names of birds. The jackdaw has been so named because he calls "Ja-a-ck, ja-a-ck" very clearly, and if you listen to sparrows you will hear them say "Phillip, phillip" as they chirp. Those two explain themselves, but many of the others are affectionate pet names. They were given those names long ago, and are something of a puzzle today.

Take the case of the goldfinch, for instance. He is the most brilliantly coloured of all the finches to be found in Britain. Black, gold, crimson, russet, and white are all found in the uniform he wears. In the south and Midlands he is often called "the sheriff's man," on account of his colouring, which is, indeed, that same colour scheme seen in the uniform of a sheriff's officer even today. Another of his names is the "seven-coloured linnet," and he is also called "nicker" or "nikko," because of his pleasant little twitter when in conversation with his fellows. In Scotland they call him the thistle finch because of his fondness for thistle seeds.

NICKNAMES FOR BIRDS

The starling—that hustling, bustling bully of a bird—has not so many names as one would expect in view of his close association with man. In the north he is named the shepster, on account of his habit of sitting on the backs of sheep and picking off ticks and catching the flies and other insects which they disturb as they crop the grass. Starlings, by the way, are great mimics. They have no real song of their own. True, they will sit sizzling and gurgling like a freshly opened bottle of soda-water, but they have no song. They imitate all kinds of other birds and creatures, however. There was once one which called "Jean," exactly like a little girl would

STARLING AND YOUNG

This bold bird imitates the song of others In its untidy nest, loosely made of straw, grass, and moss, the starling has a family which is usually of five or more chicks The nest is often in a hole in an old tree or building, in a thatched roof, or even in a hole in the ground The mother starling feeds her hungry youngsters on wire-worms and other insects which cause harm to vegetables and other crops, but adult starlings eat fruit and growing corn Because of their habit of collecting in large flocks they can be one of the farmer's worst enemies among the birds

BARN OWL

Hunting mostly at night, the barn owl feeds chiefly on rats, mice, and voles, and on beetles and other insects, on which it pounces silently. After a meal the owl brings up pellets which contain all the unwanted bones and fur or feathers of creatures it has eaten. The owl's nest may be no more than a ledge on the side of a cliff. In it will be found young birds of different ages. This is because the eggs hatch at different times instead of all on the same day, as is usual with other birds. The top picture shows a barn owl returning to its nest with a field-mouse which it has caught to feed its young.

SONG-THRUSH

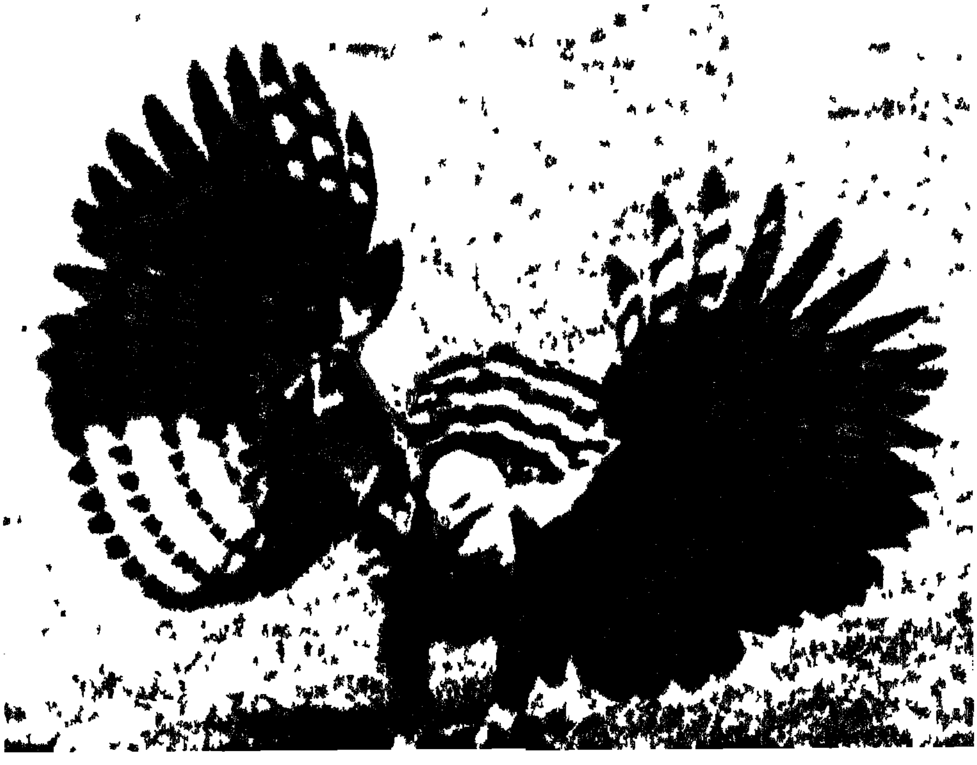
In spring the cheerful call of the song-thrush tells that nest-building is soon to begin. The cosy nest is lined with a smooth layer of dried mud. Like chicks of other tree- or hedge-nesting birds, those of the song-thrush are at first helpless and depend entirely on their parents for food. As soon as they have their feathers and are able to fly, their parents prepare for a second brood which the members of the first may help to feed. Thrushes eat many garden snails, smashing their shells by beating them on a flat stone.

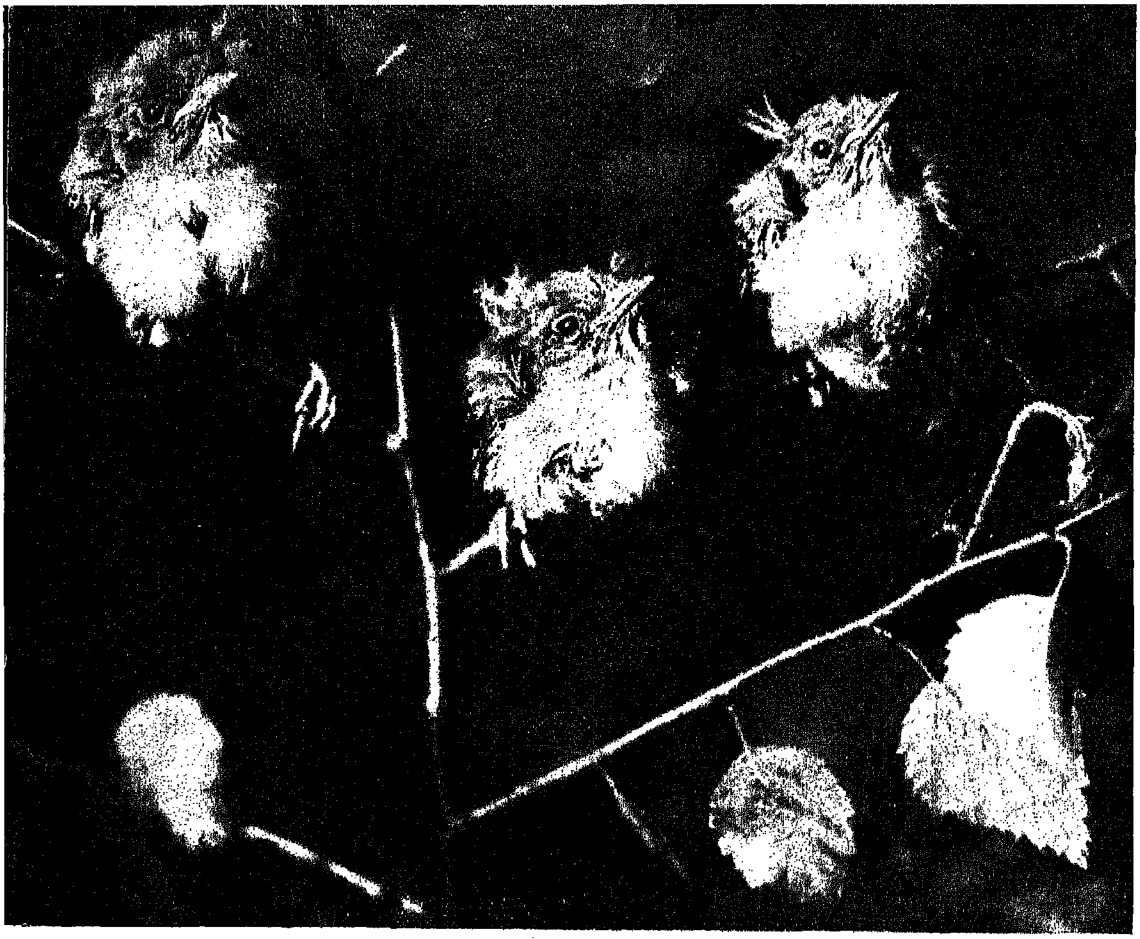
COMMON TERN

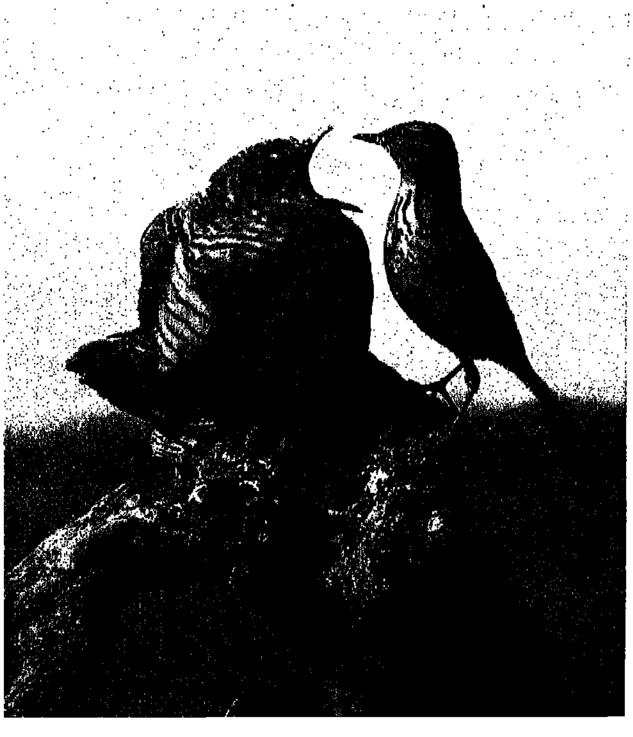
Terns nest on cliffs and beaches, sometimes in such dense colonies that it is dangerous to walk among them, since they will attack anything they think will hurt their chicks. Here the mother tern is shown returning from the sea with a fish she has caught. She feeds her chick without landing and flies off to hover again over the sea with head and tail bent downward and back strongly arched ready to dive to catch another fish. The cock bird also helps to feed the young, of which there are seldom more than three

GOLDEN EAGLE

Eagles are no longer common in England, but may be found in the highlands of Scotland. Their favourite nesting site is a ledge on the face of a cliff. If undisturbed they will return to the same spot year after year. The golden eagle lives chiefly on hares, rats, and grouse, though it can carry off a young deer or lamb. It kills its prey with one blow from its sharp claws. As the photograph shows, the golden eagle can use its great wings as a brake to check its speed when alighting on the ground







WILLOW-WARBLERS

The willow-warbler is very like the chiff-chaff, both in size and colouring, but its distinctive song is quite different. The little birds above *have only recently hatched in a nest in the tall grass beside a hedge. They are perched on the branches of a black poplar and will soon be busy on the fruit trees gobbling up greenfly and other insects.*

MEADOW PIPIT AND YOUNG CUCKOO

When in flight the cuckoo is easy to recognize because of the slow movement of its wings. It usually reaches Britain about the middle of April from countries south of the Equator and returns there in August for the winter. Cuckoos lay their eggs in the nests of other birds As soon as the egg hatches, the young cuckoo lifts the other eggs or chicks on to its hollow back and tips them out of the nest. In this picture a cuckoo chick (left) *is being fed by a meadow pipit.*

do. It had nested on a house where two children lived, and had evidently heard Jean called so often that it learnt the word and pronounced it perfectly. Again, a starling has been heard to call like a curlew. Some have been known to imitate the cries of terns, and one starling could whistle exactly like a farmer calling his dog. Even the dog was sometimes tricked by it.

The name magpie is at first a little puzzling, until one remembers that the word pie means pied or piebald—black and white, that is; and, incidentally, another black-and-white bird—the oyster-catcher—is known as the sea-pie for the same reason. The word *mag* comes again from the bird's call.

Apart from these names which have been given to familiar birds and which are interesting in themselves, there are others which, because they are incorrect, can sometimes lead to misunderstandings and mistakes.

NAMES WHICH MISLEAD

The name sparrow is such an instance. There are two species of sparrow in Britain, the house-sparrow, which everybody knows, and the much rarer tree-sparrow, but several other birds are also called sparrows. The hedge-sparrow is really not a sparrow at all. It does not even belong to the same family, the finches, but is more nearly related to the robin. Then in some parts of the country the reed-bunting is called the pit-sparrow and water-sparrow, though again it is not a relative of the sparrow at all. So it is always important to take care over the local names of birds, for they can be very misleading.

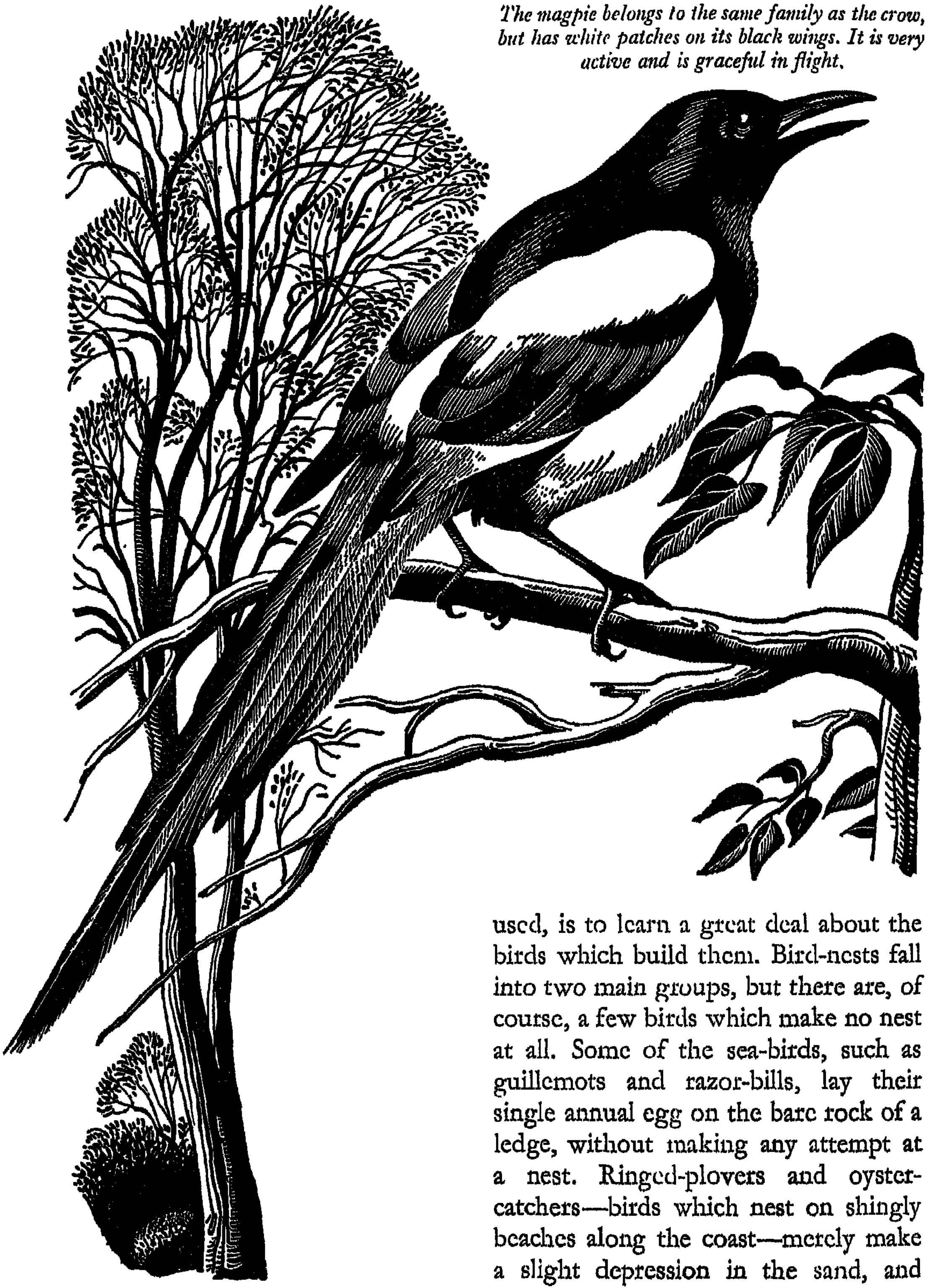
One further instance of this is the tits. Everyone knows the tom-tit or blue-tit, and most people also know the great-tit. The coal-tit is less well known and is often taken for a dirty tom-tit. The marsh-tit is rare and local and need not trouble us, but the long-tailed tit is well known. The confusion comes in when one hears, or reads, of the bearded-tit of the Fen country, which is not a member of the family at all, its proper name being "bearded reedling."

STUDYING NESTS

One of the most fascinating studies one can make is that of nests and eggs. Few things in the world have the perfection of form of a bird's egg, and few things, except maybe flowers and butterflies, show such variety of lovely colourings and markings. The trouble is, of course, that many people when they see eggs in a nest have the itch to take them. This is difficult to understand, for anyone who examines an egg collection will see that most of the colours fade and change fairly soon, and indeed there is very little real value of any kind in such a collection. Possibly the only value lies in the fact that the finding of the eggs and learning to identify them is a part of the interest of bird study, but after that they are no more than rather uninteresting souvenirs, and there are very much better souvenirs which one can obtain by taking photographs, or even making drawings of nests.

To study nests, the ways in which they are put together and the material

The magpie belongs to the same family as the crow, but has white patches on its black wings. It is very active and is graceful in flight.



used, is to learn a great deal about the birds which build them. Bird-nests fall into two main groups, but there are, of course, a few birds which make no nest at all. Some of the sea-birds, such as guillemots and razor-bills, lay their single annual egg on the bare rock of a ledge, without making any attempt at a nest. Ringed-plovers and oyster-catchers—birds which nest on shingly beaches along the coast—merely make a slight depression in the sand, and there are other species with equally simple ideas. The point is that young birds hatch from eggs in varying stages of development.

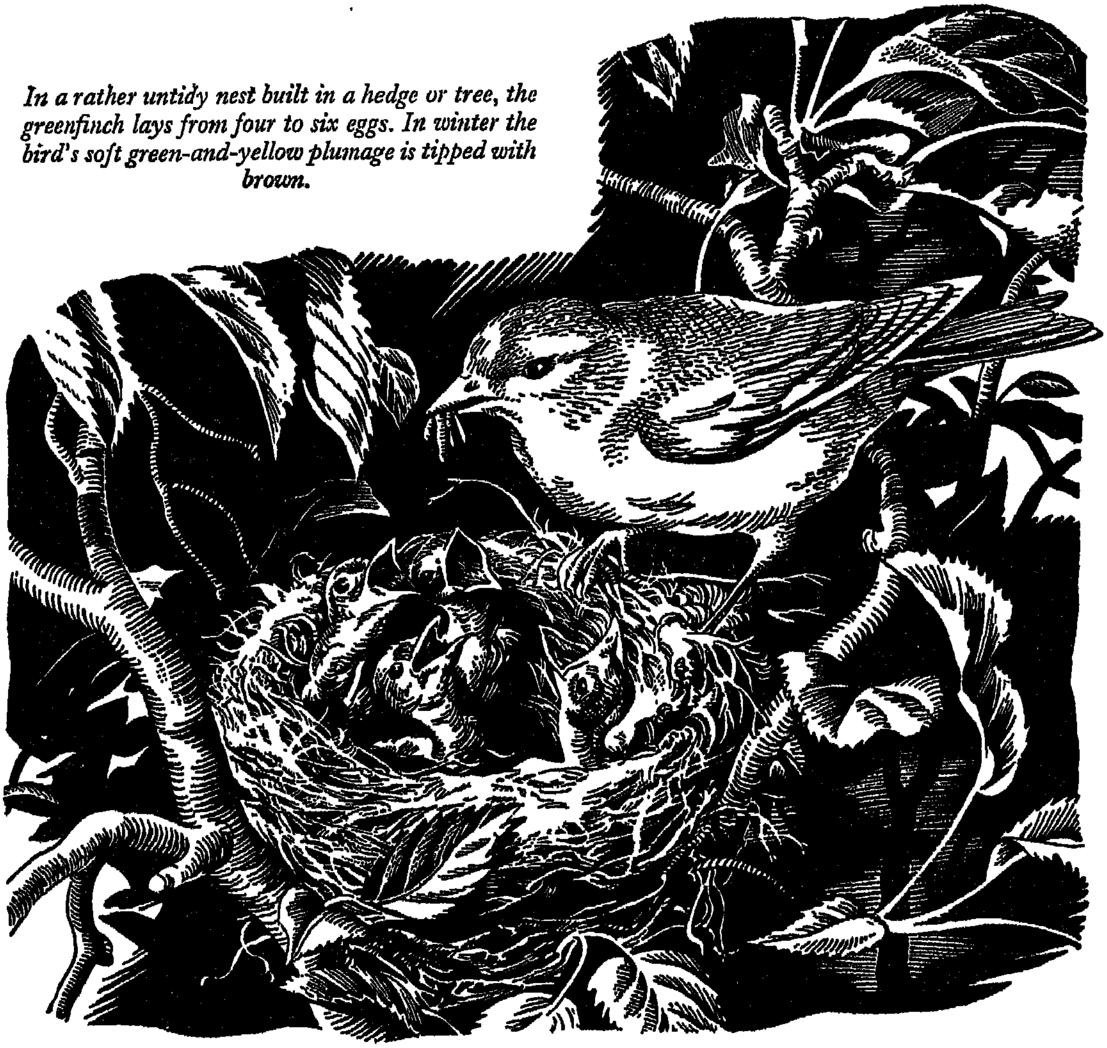
Some species hatch out in a very advanced state and can run within a few minutes. One observer tells how he sat watching a baby moorhen struggle out of the shell. It was a hot, sunny day, and the nest was built among reeds right on the edge of a pool. The chick's down dried in a minute or two, and it sat there looking round as though surprised at the world into which it had just arrived. Our friend lifted his hand so that the shadow passed over the nest. Instantly the chick dived into the water and swam into the shelter of the reeds. It was less than five minutes old and had never seen its own mother, yet it took immediate action when the shadow of the hand moved across it, and, furthermore, it knew how to swim and where to go for safety.

Many chicks hatch in that advanced state of development, and you will find that with such birds the nests are rarely very well built. There may be quite a lot of material, as in the nest of the moorhen, but that will only be to lift the eggs well above the damp ground or the water surface. The cup of the nest will be shallow so that the young can easily scramble in and out if need be. Similar nests are built by gulls and the game-birds like partridges and pheasants. Indeed, all the species whose young hatch out in a well-developed state, so that they can run and hide, make nests with shallow cups.

Among the perching birds, or passerines as they are termed, the young are usually very undeveloped. Thinly covered only with down, for several days they cannot even stand or hold up their heads properly. They are quite helpless, and often remain in the nest for three or four weeks before their feathers grow and they can begin to think about venturing abroad into the

Jackdaws build their nests in April in holes in cliffs and rocks or in trees or church towers. Like the magpies, they frequently steal the eggs from the nests of other birds.

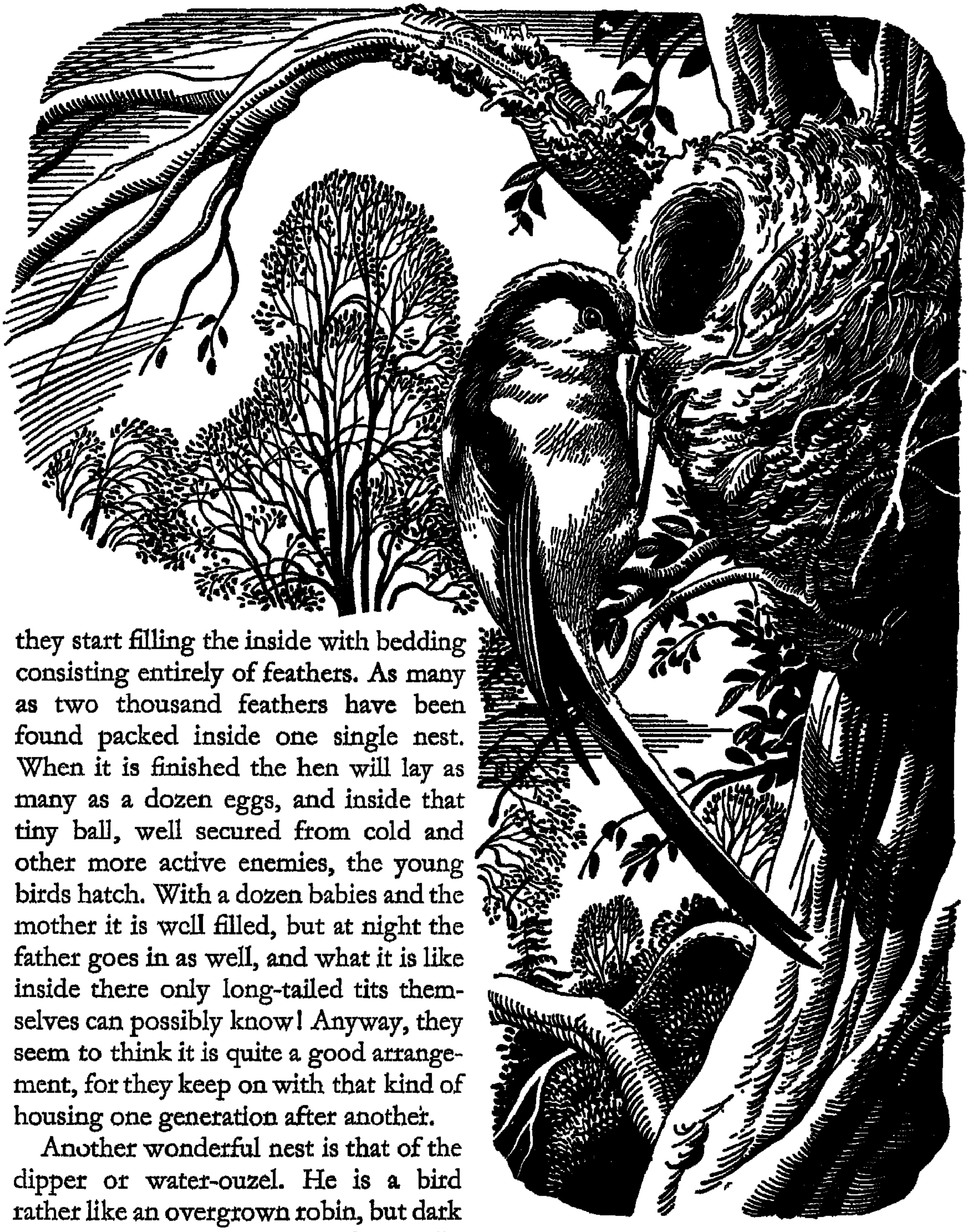
In a rather untidy nest built in a hedge or tree, the greenfinch lays from four to six eggs. In winter the bird's soft green-and-yellow plumage is tipped with brown.



world around them. Such birds, then, will require nursery, or "cradle," nests, and so you find that their parents build strong and deeply cupped nests in which the chicks can keep warm and will not be in danger of falling out.

We first distinguish, then, between shallow nests for the nest-quitting species and nursery nests for the ones which need protection for several weeks. But that is not all. The nursery nests themselves vary tremendously. From the mud-lined cup of the song-thrush to the marvellously constructed affairs built by long-tailed tits and dippers there are very many stages.

Few nests found in Britain have the strength and wonderful construction of the weaver-birds of the Tropics, but that of the long-tailed tit gets very near. It takes about a fortnight to build, and is made largely of moss and grass matted together into a strong kind of felting. It is about as big as a man's fist, and has an opening at one side near the top. When the oval-shaped felted work is finished the birds cover the outside with bits of moss and lichens to camouflage it. Then



Graceful and hard-working, the long-tailed tit lines its nest of grass and moss with downy feathers.

they start filling the inside with bedding consisting entirely of feathers. As many as two thousand feathers have been found packed inside one single nest. When it is finished the hen will lay as many as a dozen eggs, and inside that tiny ball, well secured from cold and other more active enemies, the young birds hatch. With a dozen babies and the mother it is well filled, but at night the father goes in as well, and what it is like inside there only long-tailed tits themselves can possibly know! Anyway, they seem to think it is quite a good arrangement, for they keep on with that kind of housing one generation after another.

Another wonderful nest is that of the dipper or water-ouzel. He is a bird rather like an overgrown robin, but dark grey in colour with a white breast. In some parts dippers are quite common.

Seldom found far from water, the ringed-plover's nest is little more than a hollow in the shingle or sand.

The oyster-catcher is a strong flier and it survives the stormy winds around the coast of Britain. The bird shown below is seen in its summer plumage, which is glossy black on the head, upper breast, and back. It is more common on the west coast than on the east. These birds are able to run along the shore so quickly that their legs are hard to see.

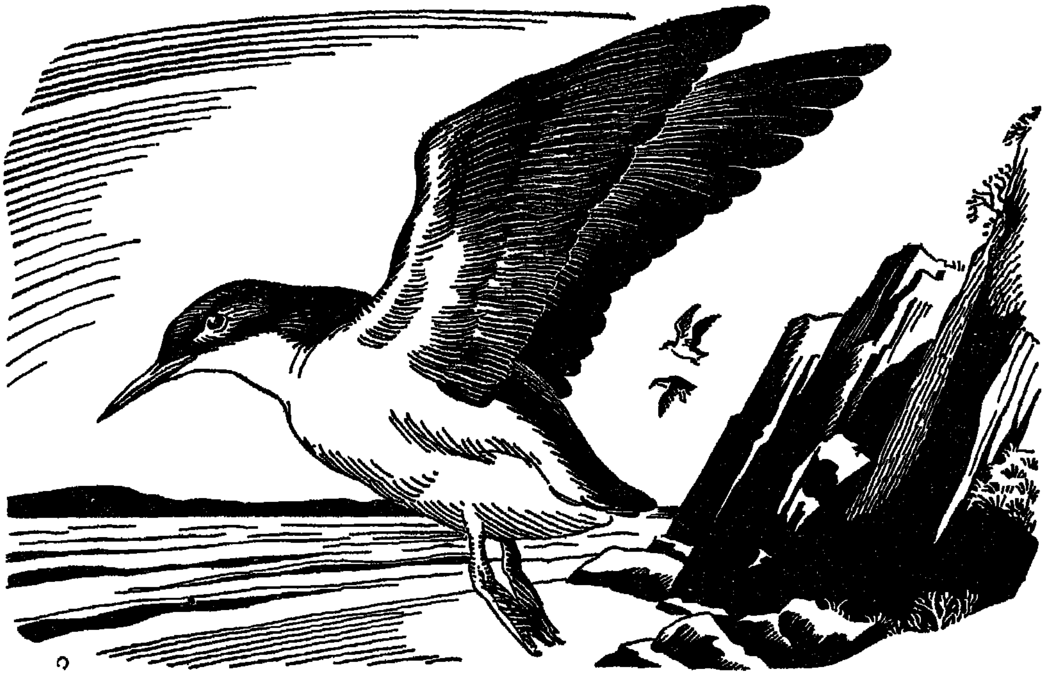
One nature lover was once walking along a river bank where there is a little side stream which used to carry the water to a mill-wheel. The banks have fallen in in some places, and trees have thrust their roots through the soil down into the water. Reeds and flags grow along the banks, and here and there a great rock forms a little eddying pool where one can watch trout as they drift from side to side, taking in the flies the stream carries along. A kingfisher flashes from under the high bank where he nests most years. On turning a bend there could be seen a dipper standing on a stone in midstream, and he held in his beak a piece of grass. He was doing the usual curtsey, which is apparently merely a habit and is not done as a compliment to anyone in particular. No one knows, by the way, exactly why dippers do curtsey. It was the piece of grass he held in his beak which was of particular interest. Soon his mate could be seen busy on a half-finished nest which was being built among the roots of a tree out over the stream. The building operations were just at the stage when the covering of the nest was being woven. Perhaps the nest should first of all be explained a little.

The first stage is to make a solid platform, which usually consists of mud and grass or fine roots. On top of this a cup of grasses is next woven and made quite firm. Then grasses are made to form a kind of tent over the whole thing, an opening being left just below the step of the cup, so that the birds enter the tent from below. When the tent is finished it is usually covered over with bits of moss and any other material from the immediate surroundings—dead leaves or anything else which will camouflage the whole construction—and it is often extremely difficult to see, as it so perfectly matches the surroundings. As a rule it takes seven or eight days to finish, and is not only elaborate, but several different kinds of material are used in the building.

Found only near lakes and rivers, moorhens build their nests of rushes and grass. They feed on insects, worms, slugs, seeds, and water plants.

One of the pair of birds could be seen coming along with a piece of grass and weaving it into place. Then the other partner would arrive and weave in his or her bit. Never once will the same bird put in two consecutive bits of grass. If it arrives out of turn it will stand and wait until the other partner arrives and takes its turn; first the hen, then the cock, then the hen, then the cock, and so on alternately all the time. The work they put into that nest even in a few hours is quite extraordinary and vastly interesting to watch, and to see a thing like that actually happen is surely far more interesting than egg collecting.

A series of notes on nests one finds, their situation and the materials of which they are composed, the number of eggs they contain and, if possible, a photograph or drawing, will be of real value and interest for years. Far more so than scores of empty egg-shells which



On rugged cliffs beside the sea the guillemot makes its home during the breeding season. This bird does not make a nest, but the hen lays her eggs high up on a rocky ledge. During the spring and summer the bird's plumage is brown and white, but with the approach of winter some of the brown feathers are replaced by white ones, especially about the head. At this time of the year many of the birds fly north from Britain and spend the winter in Scandinavia. This is unusual because most of the birds that are in Britain during the summer fly south for the winter.

slowly fade and one by one get broken.

Anyone who studies nest construction will find that there is much to learn. For instance, most birds which produce white eggs either nest in well-hidden places or else make some sort of covering which hides the eggs from view. Eggs which are left fully exposed, like those of the peewit or ringed-plover, are coloured and marked in such a way as to make them difficult to see. The colourings and markings of eggs nearly always have camouflage value when seen in their proper place—the nest.

A good example of this kind is the little tern or sea-swallow. These birds nest on the seashore, usually on shingle. They do not make a nest, but just lay their two, sometimes three, eggs among the stones. As the eggs are coloured and marked like pebbles, they are difficult to find, and often the only way one does find them is by noticing two pebbles almost exactly alike lying together.

On one occasion an ornithologist—that is to say, one who studies birds and their habits—was making pictures of these particular birds. He had his hiding-tent set about five feet from a bird who was sitting. Suddenly she shot into the air and began to make the screaming noise of alarm. Feet could presently be heard crunching on the shingle and, looking through the peep-hole in the back of his tent, our friend saw a man and five lads coming along the beach.

Like guillemots, puffins and other sea birds, razor-bills nest on the cliffs around Britain's coast. They are seen on land only during the nesting season, or when their bodies are washed ashore after a storm, or when their plumage has become saturated with oil which prevents them from flying.

When one is lying close to the ground sounds travel very clearly, and whilst they were still a long way off the boys could be heard discussing the tent, unable to decide what it was, but determined to find out.

When the intruders were about thirty yards away, much to their surprise the occupier of the tent crawled from underneath the flap and explained that, until they had come along and upset things, he had been photographing a bird. On inquiring where it was, they were directed, with a belated warning, to look above their heads. But it was too late: the little tern dived down at one of the boys and hit him quite a hard blow on top of his slouch hat. After making another attack and circling round for several minutes, the bird eventually flew out over the sea. The boys then wanted to know how the bird had been persuaded to sit just in front of the tent. This, it was explained, was quite easy, as she had her eggs there and was sitting on them. Eggs, of course, interested them at once, and they began to wander round, but although the lads and their companion stood no more than three feet from the two eggs they could not see them until they were pointed out. They were astonished and quite unable to believe their eyes.

That is camouflage, and you will find in studying birds, whether you are on the seashore or inland, on banks along lanes, in open fields, in woods or along river banks or in the middle of a marsh, that camouflage as practised by birds is far more efficient than any which man has designed.

One thing is always necessary. To learn the ways and see something of the family lives of birds one must always remember that they are among the most wary of all living things, and for that reason need to be approached with care and every caution, and with consideration also, for of what use is it to find a nest and cause it to be deserted, or take eggs when, by watching from day to day, one can watch the chicks grow and develop, and learn far more than all the egg collections in the world ever taught.

A rough tangle of twigs and roots lodged in a forked branch of a yew tree or in a hedge or bush serves as nest for the bullfinch. In spring and early summer this bird feeds almost entirely on buds from fruit trees.

Wild animals of Britain

As you go about in the countryside of Britain you will see very few wild animals at first. This is because they are all shy of human beings, and either slip quietly out of our way or lie very still when we approach. You can, however, often tell which wild animals live near-by if you know about the kind of country that they like and the kinds of food on which they live.

For instance, most people know that rabbits like places where there are plenty of trees and hedges and banks of soft soil where they can make their burrows; and we know, too, that the rabbit lives on grass and other greenstuff. Not everyone who finds rabbit-holes could tell you whether or not they were occupied, and the holes may well be empty, because the farmers try to kill as many rabbits as they can. If around the holes you find fresh rabbit droppings you can be sure that rabbits live there.

These droppings are not left all over the field, but in definite tracks or runs, and by following them from the holes you can trace the runs that the rabbits make. Even if there are only a few droppings you can follow the runs for a surprisingly long way, for the grass in them is more beaten down than it is in the rest of the field. In this way you can find the rabbits' favourite feeding-ground.

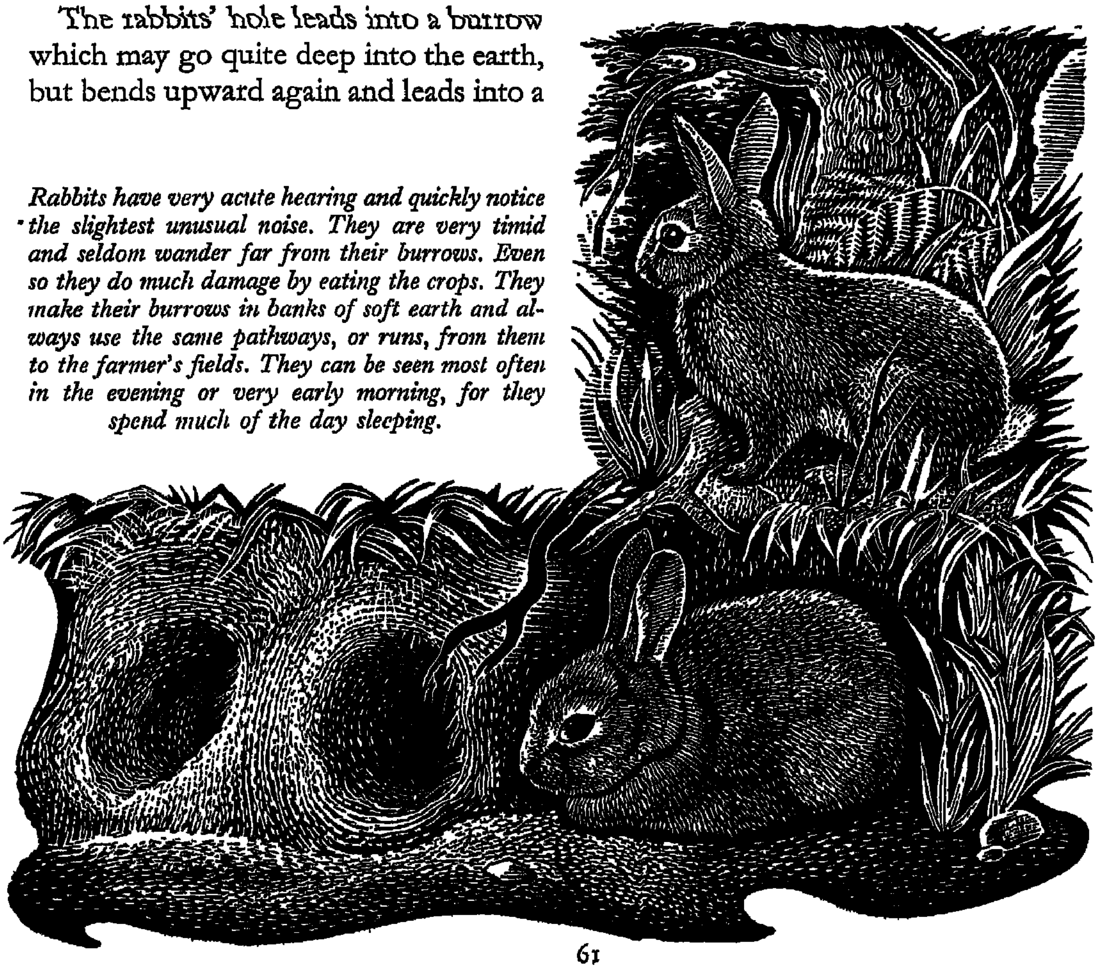
All animals leave telltale clues of this kind. Some, like the rabbit's, are well known and easy to spot: later on we shall find out about some of the lesser-known animal signs that you can see.

Once you have discovered where the rabbits live and feed you will be able to see them if you lie hidden when they come out. Rabbits, like many other wild animals, spend most of the daytime hiding or sleeping, so if you want to see them you must watch for them in the evening or early morning. Then you will find them peacefully hopping about in the runs outside their holes. As they move about they throw their long shadows across the grass and stop here and there to nibble a tasty weed. If you make a sound that frightens them, up they go on their haunches with their ears in a capital V, then without wasting any time they scuttle for home and safety.

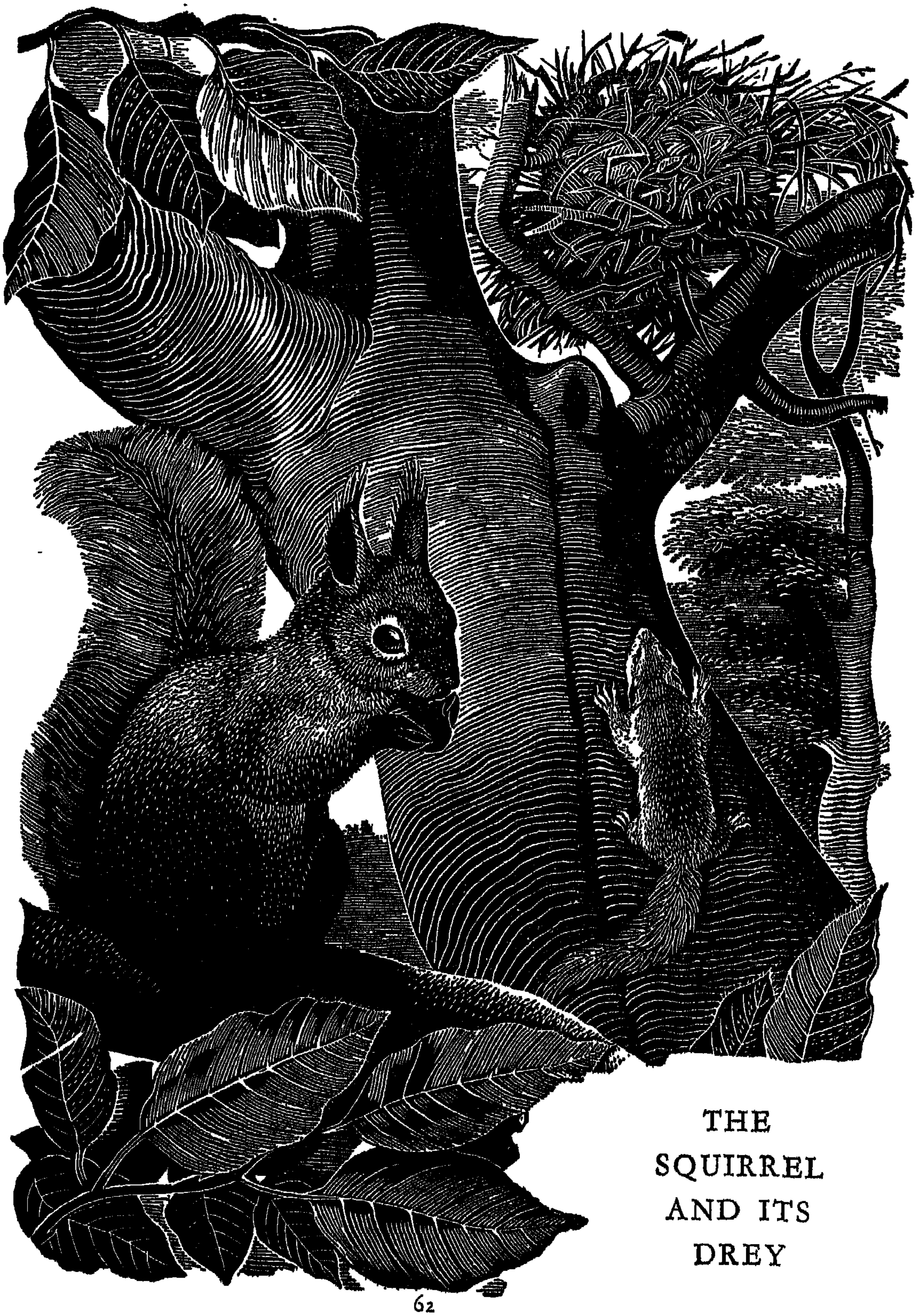
Rabbits are expert runners and can get along even faster than hares, but they cannot keep it up for as long as the hare does, so they do not wander as far from home. Some people say that when a rabbit runs it really makes one huge hop after another. It pushes off with its powerful hind legs and, as it bounds through the air, brings them forward in front of the fore-legs ready for the next leap. But whether rabbits run or hop, they soon get home and disappear into their holes.

The rabbits' hole leads into a burrow which may go quite deep into the earth, but bends upward again and leads into a roomy cavern which has several escape holes leading out. Having the burrow curved in this way helps to keep the living-room well drained during rainy weather.

In the spring the mother rabbit makes a special nest and lines it with fur that she pulls from her own coat. When the youngsters are born and settled in the nest they are helpless little fellows with great floppy ears. They cannot see or hear, and at first they do not even have any hair. They grow quickly on their mother's warm milk, and by the time they are about a fortnight old they look



Rabbits have very acute hearing and quickly notice the slightest unusual noise. They are very timid and seldom wander far from their burrows. Even so they do much damage by eating the crops. They make their burrows in banks of soft earth and always use the same pathways, or runs, from them to the farmer's fields. They can be seen most often in the evening or very early morning, for they spend much of the day sleeping.



THE
SQUIRREL
AND ITS
DREY

much more rabbity and become quite adventurous. They push their noses out of the nest, then, if mother does not seem to mind, fore-paws follow noses, and hind-paws and tails as well. If the weather turns cold they huddle back quickly into the nest and help to keep one another warm.

Soon the mother rabbit teaches the babies to feed on some of the grown-up food that she eats, and by the time they are about five or six weeks old they can live entirely on grass and other greenstuff.

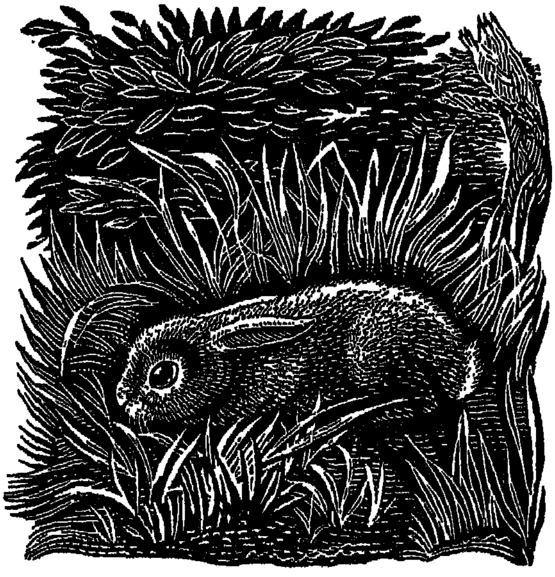
Not only does the mother rabbit teach the youngsters how to feed themselves, but they learn many other things besides. They learn who are their friends, and who their enemies; they learn when they see danger in the distance to crouch motionless so that they are not noticed. If danger comes too close they run for their lives. They learn the tricks of the chase—to twist and turn and to throw a false scent. But however clever a rabbit may be it is not likely to die of old age. Sooner or later it has its last accident, and, though we may think rabbits have attractive ways, they rob us of so much food that we cannot be sorry when they are killed.

Rabbits, like many other wild ani-

The hare does not burrow into the ground as does the rabbit, but lives in a lair, called a form, which it makes among tall grasses. Because the hare often gets into its form by making a great sideways leap, there is no trail to lead enemies to the form.

mals, are covered with fur, and feed their youngsters on milk. Animals that do this are called mammals, and other interesting mammals are hares, squirrels, mice, and rats. All these mammals have sharp, chisel-shaped front teeth that they use for gnawing and, like rabbits, are called rodents.

There are many other mammals besides rodents: stoats, weasels, foxes, badgers, and otters, for instance. Unlike rodents, which live entirely on plants, these mammals feed on the flesh of other animals, so we call them carnivorous mammals. Then there are the deer. These large animals feed entirely on vegetation: nowadays most of them live in parks, and are not wild in the ordinary sense. Among the true wild mammals there are the shrews, hedgehogs and moles, which feed on insects and other small things and, finally, feeding also on insects, are the only mammals that fly—the bats.



When danger threatens, many wild animals crouch down and keep perfectly still, as the young rabbit is doing in the drawing. In this way they often escape, because they are hard to see amid the tangled undergrowth.

Nearly all these mammals have the wonderful power of keeping themselves warm and of stopping themselves from becoming overheated. To keep a steady temperature in this way is a great advantage, because the cold of winter is less of a problem and it is not so necessary to hide away from the sun in hot weather.

Many mammals, therefore, can be seen about during the whole year, and come out in all weathers. Even on cold, frosty evenings in the autumn you will sometimes see a hare as it crosses the fields on its way to feed. As it swings steadily along it is easy to see that it is much larger than the average rabbit, and though hares and rabbits live on similar food, you do not usually find them in the same kind of countryside. Hares do not burrow; instead, they make a nest in the long grass and lie curled up in it all day. This nest is called a form, and so still do hares lie in their forms and so skilfully are they concealed by the long grass or corn-stalks around them that they are difficult to find.

Even wild animals do not very often surprise hares in their forms. This is because when hares return home they usually run to one side of their form and then give a great sideways leap into it and so break the scent. Even if a fox does track him back home, the hare sleeps so lightly that the fox will have to run hard to catch his supper.

Neither rabbits nor hares can climb trees; in fact, very few rodents can.

Fox
Squirrel
Red Deer

BIRDS OF PREY

Among those that do are squirrels. They spend most of their time in trees, and you can find them in woods where beech, pine, oak or hazel trees grow. As you search about among the fallen leaves you will come across little piles of empty hazel-nut shells. If the shells are cut neatly into halves, you can be pretty sure that a squirrel has eaten the kernel and that there is a squirrel's nest overhead.

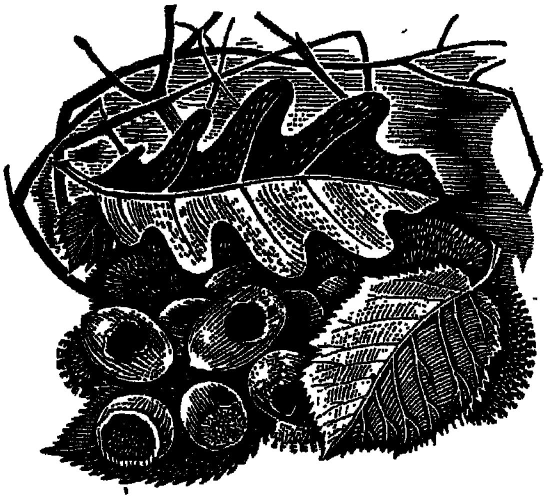
A squirrel's nest is called a drey, and when you see it in the fork of a tree it looks something like a bird's nest. If you climb up to have a look at the drey, be careful where you put your hands if the mother squirrel is at home or you may learn why she is able to cut those nutshells so neatly! Her front teeth are sharp chisels and she has a powerful bite. Though she looks attractive, she can show a wicked temper, and will scold you from a safe distance until you leave her in peace. Moreover, squirrels can be spiteful, for though they feed on nuts and other vegetation, they also rob birds' nests of the eggs, and even carry off the helpless nestlings as well. There are two kinds of squirrel, and of these the grey one is commoner than the red.

This is interesting, because the red one has lived in Britain longer than the grey, which was brought over from America. Squirrels are occasionally about in the woods on mild days in the winter, and sometimes they damage trees seriously by eating the bark. Few people in the countryside really like squirrels, for they make themselves a nuisance by eating the farmers' crops, damaging the saplings of the fruit-growers and foresters, and stealing from game-birds' nests.

The various field mice can also be serious countryside pests. These are the long-tailed field mice, the harvest mice and another mouse called the short-tailed field vole.

You can always tell if field mice are about, for in the hedges you will find empty nutshells that have not been opened by squirrels. Instead, they have round or oval holes cut in their shells, and you can see the grooves that the mouse's tiny chisels have left around the hole. Long-tailed field mice are very destructive and rob us of much of what we grow. Luckily they have many enemies. When they are out feeding at night not only do carnivorous mammals like stoats, weasels, and foxes chase them and eat them, but owls and other birds of prey do, too.

When an owl spies a field mouse it drops down noiselessly and pounces on



The holes in these nutshells, acorns on the top and hazels underneath, show that the nuts were eaten by field mice. These little creatures cause a lot of damage and are very destructive.

When in danger the field mouse (BELOW, RIGHT) *stays very still in the hope that it will not be seen. It has many enemies among the birds of prey, and often falls victim to the owl* (ABOVE), *which swoops down noiselessly.*

it. It pops the mouse into its mouth and swallows it whole. Inside the owl the field mouse is sorted out, and all the useless bones and fur are cleaned of flesh and made into a neat "parcel," which the owl brings up through its beak and drops on to the ground. In these oval owl-pellets you can find not only the remains of field mice, but sometimes also the skulls and teeth of short-tailed field voles.

Although there may be many of these shy little rodents in a district, you do not often see field voles because, like field mice, they come out only at night. But they give themselves away by their runs in the long grass. These runs are often roofed over with dead grass-stalks, not because the voles have put them there, but because they have gnawed through their lower parts and left the tops to die.

When a farmer's crops are harmed he often blames field mice, when really field voles have done the damage. Sometimes there are so many of them that they become a serious plague, and, by burrowing into the soil for seeds, may destroy the corn before it comes up.

Like field mice, field voles are small, and make a food store in their burrows before hiding away for the winter. In the spring they bring up a family of youngsters, and almost as soon as the members of the first family are old enough to look after themselves their parents produce another litter. They may have several litters in a season, so it is not surprising that sometimes they are very numerous.

The smallest of all rodents to be found in Britain is the harvest mouse.

Unlike field mice and field voles, this little fellow is about in the daytime. During the winter it feeds in corn-ricks, but when the warmer weather comes along it turns out and picks up what it can find in the shelter of hedges. Then in the summer it goes into the fields to find grass seeds and ears of corn. Nowadays harvest mice are rather scarce; probably because the up-to-date harvesting machines cut the corn so rapidly that the little harvest mice in it have no time to escape, and many are killed.

These three rodents—field mice, field voles, and harvest mice—are all small, and all have a steady temperature. None of them weighs more than an ounce, and a harvest mouse weighs less than half an ounce. Just as little drops of hot water cool down more quickly than a large quantity of it, so these little rodents would cool down rapidly if they did not eat great quantities of warming food. Not only do they eat a lot for their size, therefore, but also they all have large families. So they have to spend most of their time either in feeding or in searching for food. Since their taste in food is similar to ours they may become serious pests.

One of the voles—the water vole—however, is a harmless fellow. He is much larger than the field vole, and instead of stealing our food he lives almost entirely on water weeds. Water voles are good swimmers, and can swim under water as well as with their noses

Among the poppies and the corn the harvest mouse builds the nest where it rears its family. The nest is made of plaited grass. These tiny rodents are now rarer than they once were.

Farmers and gamekeepers hate the fox because of the damage it does. Sometimes it will kill all the chicken in a hen-roost though taking only one for food. It has a powerful scent, but is a cunning animal, often swimming a long way up or down a stream in order to break the trail and mystify its pursuers.

above the surface. They are very shy and quickly scurry away if they see us moving. Some people call them water rats, but you can always tell a water vole by its rounded head and short tail. Neither in appearance nor in the way they behave are they anything like rats.

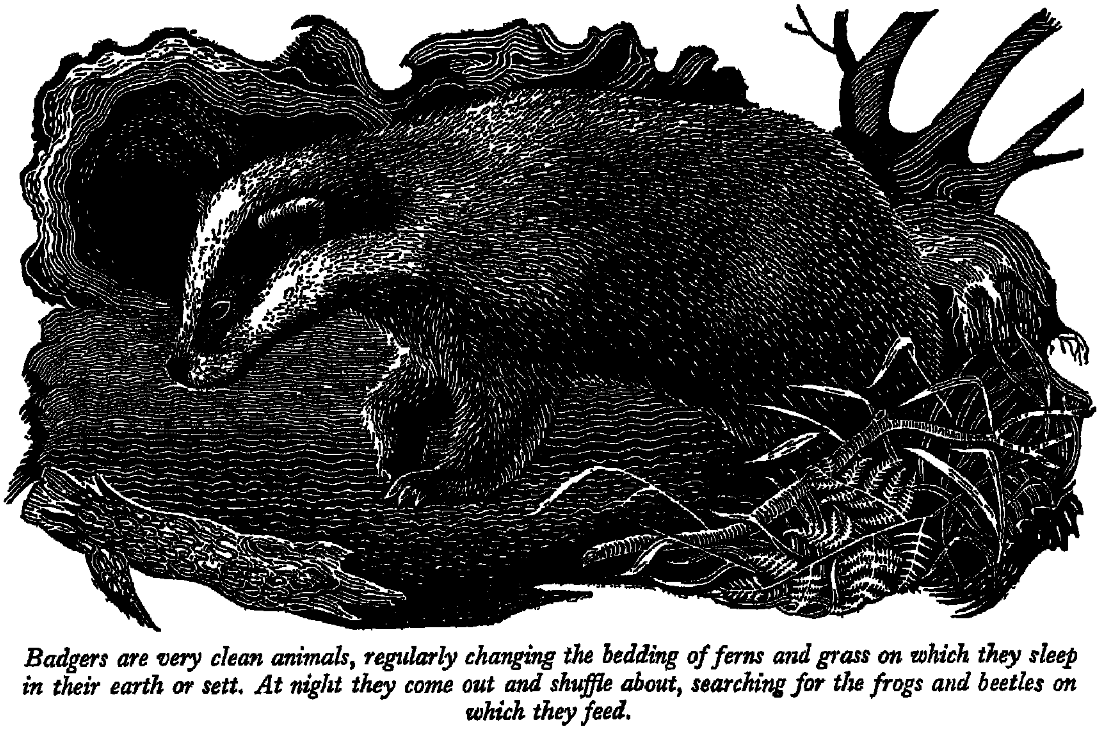
Rats are probably the most hated of all rodents. They eat our corn, greenstuff and potatoes—not to mention the bodies of dead animals, even other rats. Not only do they cost us dear in the food they steal, but they also carry diseases. We therefore do everything we can to get rid of them. Many people put down traps, but find after a time that the rats learn to avoid them, so they try poison. If the rats eat only enough poison to make them ill they learn to leave poisoned food alone. So the best way is to put out some unpoisoned food each night until the rats are used to it and come freely for it. Then if you poison this food heavily the unsuspecting rats eat it and do not live to learn their mistake.

While most rodents are pests and we try to reduce their numbers, some of the carnivorous mammals also hinder us. For instance, in some districts there are many foxes. These animals are much too fond of chicken to make them popular with poultry-farmers. Sometimes during the winter you come across the track of a fox in the snow. The footmark is about two inches long, and you can see the four toe-marks, each with a claw. Although a fox's hind-foot has only four toes, the front ones have five. So the four-toed footmark is puzzling unless you know that foxes run on the tips of their toes, and the short first toe of the fore-paw does not reach the ground. Not only that, but foxes are able to put their hind-feet down exactly in the tracks of their fore-feet, so that from their tracks you might think they walk on two legs.

If you are out during the dark nights in the depth of winter you may hear a fox yapping to its mate. Together they build a home in a hole in a bank. Sometimes they use a rabbit burrow, after having first driven out or killed the rabbits, and enlarge it to suit their needs. When the baby foxes are born they are rather lamb-like and attractive, and it is hard to believe that they are going to grow up to be the spiteful and ruthless creatures that we know them to be. Sometimes foxes seem to kill just for fun. Poultry-farmers especially hate them for their trick of getting into fowl-houses, eating one of the birds and killing the rest.

Sometimes when a fox catches a wild bird or animal it eats part of it and buries the rest as though it were going to return later. But the fox buries it so carelessly—often leaving part of it exposed—that often some other animal feasts on it.

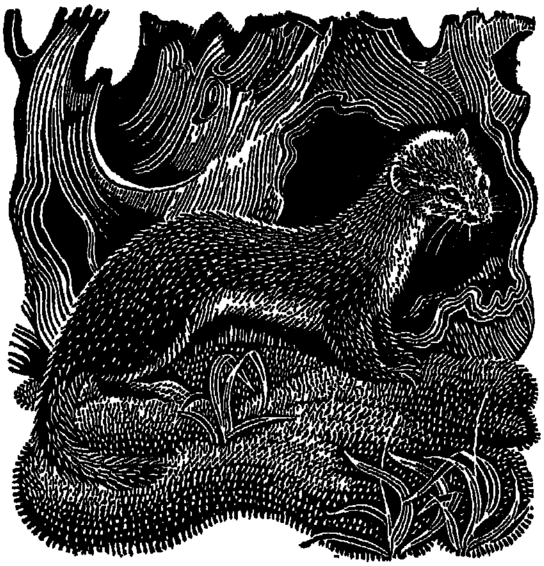
Nobody really likes foxes. They are intelligent animals, and seem to know



Badgers are very clean animals, regularly changing the bedding of ferns and grass on which they sleep in their earth or sett. At night they come out and shuffle about, searching for the frogs and beetles on which they feed.

that they have a powerful scent, for they always try to approach their prey downwind from it so that they can smell it before it smells them. If they are chased they often make for water, for they know that their scent will be lost in the water and the trail broken. Sometimes a hunted fox will dive into a stream and come out on the far bank a long way up- or down-stream from where it went in —just to make things more difficult for its pursuers.

Near the entrance to a fox's den you may perhaps find other holes in the ground. If outside these holes there are heaps of dry fern-leaves or grass, and if there are short black and white hairs scattered about, you know that you have found the entrance to a badger's den. Badgers are very clean animals, and regularly change their bedding, leaving it outside in heaps. Those whiskers that give the badger away are the same ones that are used for making good-quality shaving-brushes.



Quick and active, the weasel is always on the look out for such victims as field mice and voles. Because these creatures destroy a lot of pests the weasel is a friend of the farmer.

A badger's home is called an earth or sett, and has several openings leading into many branched tunnels. Badgers are carnivores, but are very different from foxes, for they are quiet, inoffensive animals, and only come out at night to hunt the frogs and beetles on which they feed. They are such peaceful fellows that they sometimes even allow foxes to share their setts. They may, however, get a poor reward for this kindness; for when a fox-hunt is on the huntsman closes up the entrance to the fox's den and the badger, coming back earlier than the fox, opens it again for his own convenience. So the fox is able to escape home, and because of this the hunters dig the badger out. When cornered, the badger fights bravely for its life and uses its powerful clawed fore-paws. Sometimes its flesh is cured to make badger hams.

While badgers are noted for their clean ways, stoats are well known for their ferocity. They are very quick and active, and prey on rabbits, rats, and mice and even fish.

During the winter you sometimes find a dead stoat under a hedge. If you look in its mouth you will see, near the front, the pointed, curved "dog" or canine teeth, which are so useful for gripping its prey. But when you open and close the jaws you will also see that its upper back teeth shear over the lower back ones like the blades of a pair of scissors. Teeth of this kind are useful for cutting the victim's flesh, and all the flesh-eating mammals have them.

Stoats are not only very fierce, but they are also quite cunning. They will wriggle and roll about simply to puzzle their prey, so that they come near to see what it is all about. Then suddenly the stoat pounces savagely, and one more victim pays the price of folly. Rabbits especially seem to be terrorized by stoats, and when chased by a stoat a rabbit sometimes becomes so stricken with fear that it loses the strength of its legs and is unable to run away. It waits, sometimes quietly, but sometimes screaming with terror, while the stoat comes up and buries its teeth in its throat.

Stoats have brown fur during the warm weather, and always have a black-tipped tail. Although they turn white during the winter in some parts of the country, they never lose this tip of black. Ermine is another name for the stoat, and the white fur of its winter coat provides trimmings for royal robes.

Polecats are related to stoats, and some people use tame polecats for frightening rabbits out of their burrows so that they can catch them in nets. Ferrets, which are also used in this way, are a kind of pale yellow polecat.

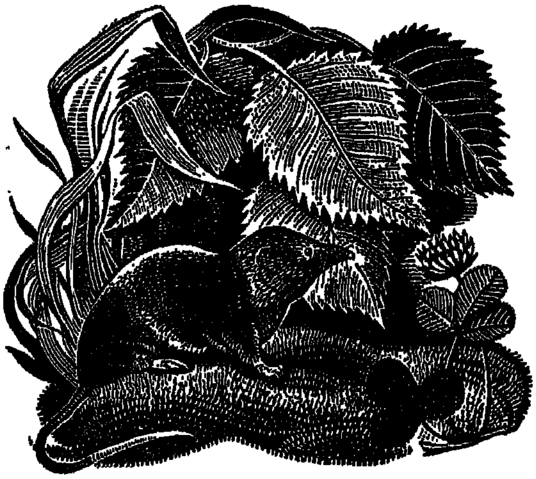
Weasels, like stoats and polecats, are also carnivores, but are much smaller than the others. They are nimble little fellows, and do much good by destroying rats and mice and even rabbits. They are not very popular with some farmers, but the good they do far outweighs any harm they cause to the farmer's chicks.

The polecat is now rare in Britain. Well known for its courage, it hunts at night for small animals. At times it may also catch eels and other river fish.

Otters are perhaps the most interesting of the carnivorous animals. An otter's home is called a holt, and is made in a hollow tree beside the water or in a hole in the bank of a stream. Here they rest during the day, but in the evening out they come for a swim and to fish.

Otters have beautifully streamlined bodies, with a thick tail. This, together with their webbed feet, makes them into very good swimmers. They are very clever at catching fish, and sometimes cunningly drive them first into the shallow water so that they can capture them more easily. They seize the fish by its back and carry it off to dry land, where they eat it. For this reason salmon fishermen do not like otters, and in some parts of the country there are otter hunts and people track the otters with specially trained dogs.

Most of the carnivorous mammals,



Shrews are active little mammals which, except for their long, pointed snouts, look something like mice. They have enormous appetites, and feed on insects and other small animals.

then, live on the flesh of other fairly large animals such as birds, fish or other mammals. But there are three very common mammals that live almost entirely on small animals such as slugs, snails, insect-grubs, and worms. These are the shrews, moles, and hedgehogs. Shrews are very common insect-eating animals and live in the hedge-bottoms and ditches. You may occasionally find a dead shrew lying in the road. If you pick it up you will see that it looks very like a mouse, except for its long snout, which helps it to find grubs in the soil.

Shrews have enormous appetites and are always searching for something to eat. They need so much that if they are without food for only a few hours they starve to death. They are always hunting, therefore, summer and winter; and in the spring they make a little nest in a hole in the ground, where they have a family. During the summer you can hear them squeaking in their runs in the long grass at the edge of a field, and though hawks and other birds of prey eat them, dogs and cats will not, even if they catch them. Some people say that this is because their flesh has an unpleasant flavour.

This is also true of moles, which, like shrews, have huge appetites. Most people have seen more molehills than moles, for these animals spend most of their time below ground. They tunnel their way along, throwing up heaps of soil, and their velvet fur, which strokes smoothly whether the hand travels from head to tail or tail to head, enables them to go backwards and forwards in their burrows without getting their coats full of soil.

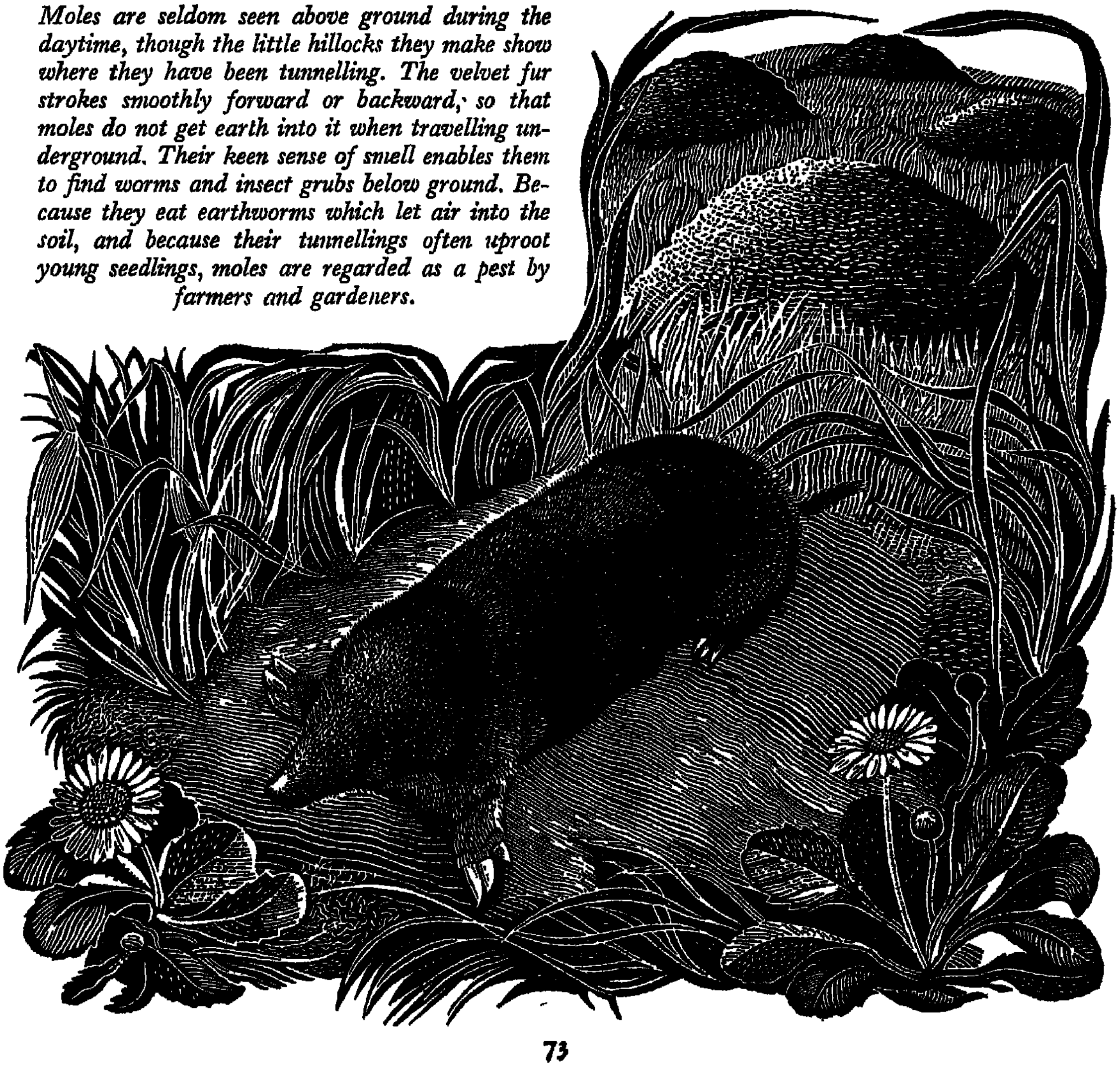
Moles are not blind, but because their beady eyes are set deep in their furry faces they have poor eyesight. They have a very sharp sense of smell, and use their long, sensitive snouts for searching out insect-grubs and worms. Farmers and gardeners do not like moles, although they do some good by eating insect pests in the soil, because they also eat our friends the earthworms, and their tunnellings and molehills often uproot young seedlings. In hayfields, too, they can be a great nuisance, because their molehills get in the way of the hay-mower and blunt its blades.

Hedgehogs eat slugs, snails, and insect pests, however, and do nothing but good. The best time to see hedgehogs is late on a summer evening. They have a curiously dignified kind of walk, and pick their way methodically about the hedge-bottoms and tall grasses, looking for insects to eat. You have to watch very quietly unless you want to see how fast they can move when they like.

Hedgehogs are not only helpful, but are quite harmless, and will never attack you. Instead, if they do not like the look of you, they quietly roll up into a ball so that their spines stick up all round. There is not much you can do about it until your prickly friend unrolls.

In the winter you may find hedgehogs curled up sleepily under a pile of fallen leaves. They spend most of the winter in a deep sleep, slowly using up their store of fat which they have built up in their bodies during the summer. So do not disturb them, but cover them over again, so that they live to do another season's useful work.

Bats, too, are very useful mammals. Everyone has seen them swooping and diving through the air in the dusk of a summer evening. They come out in the twilight and chase the moths and other



Moles are seldom seen above ground during the daytime, though the little hillocks they make show where they have been tunnelling. The velvet fur strokes smoothly forward or backward, so that moles do not get earth into it when travelling underground. Their keen sense of smell enables them to find worms and insect grubs below ground. Because they eat earthworms which let air into the soil, and because their tunnellings often uproot young seedlings, moles are regarded as a pest by farmers and gardeners.

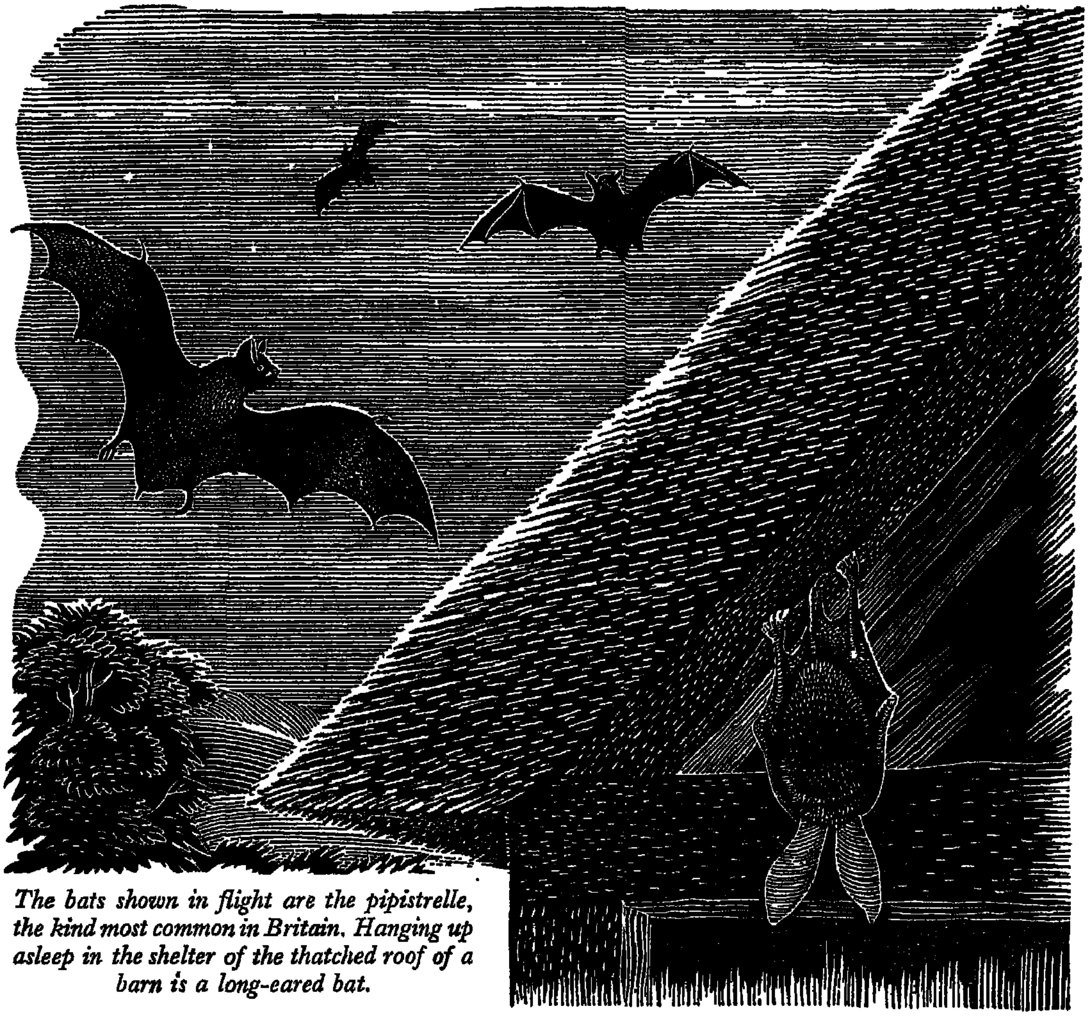
night-flying insects that they catch on the wing. If you try to catch bats, you will find what expert dodgers they are. They never seem to bump into anything, in spite of the bad light, and people once thought that this was because they had good eyesight, but we now know that they have not.

A scientist carried out an experiment, therefore, to discover how bats found their way about. He hung some strings in rows from the ceiling of a room, so that the rows of strings went right across the room. On the end of each string hung a little bell which tinkled if the string was touched. Then he caught some bats while they were asleep during the daytime, covered their eyes so that they could not see, and set them free in the room with the strings. The bats flew about among the strings, but not a single bell rang. So it seems that they have a sense that tells them when they are near something. Scientists believe that they do it by squeaking as they fly, and the squeak, bouncing back as it were from any object in their path, tells them how near they are. It is strange to think that bats have been using a kind of radar for a long time before human beings ever thought of it.

The commonest bat is called the pipistrelle, and has reddish-brown, silky fur and a mouse-like face. Like all British bats, it is quite harmless, and you need never be afraid that it will come along at night and suck your blood, as some people still believe.

During the daytime, when the bats are asleep in hollow trees and buildings, they cool down instead of keeping a steady temperature. This means that

The hedgehog is harmless and useful. It feeds on insects, including beetles. On the stone is a dor beetle, sometimes called a dung beetle.



The bats shown in flight are the pipistrelle, the kind most common in Britain. Hanging up asleep in the shelter of the thatched roof of a barn is a long-eared bat.

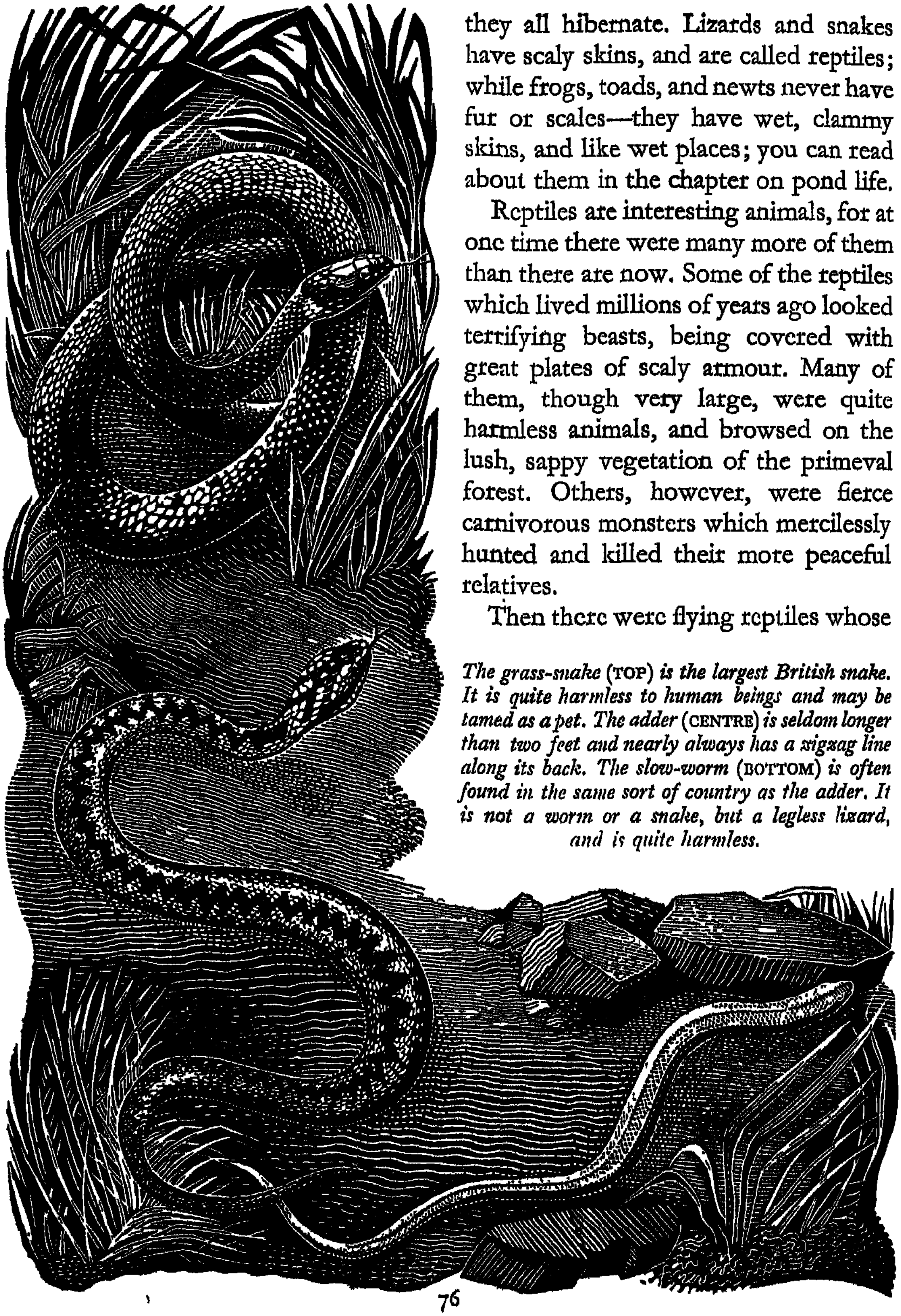
when they wake up in the evening they are stiff with cold and often have to shiver for a time to warm themselves up before they can fly off for a meal of moths and beetles.

You have probably noticed how different animals keep alive in the winter in different ways. Mice in their holes store grain and other seeds upon which they feed. Squirrels make stores of nuts, and also have a supply of fat within their bodies and, because they sleep so much, use up very little of this food. Bats, however, not only store fat, but their winter sleep is of a different kind. Their breathing is very slight, their heartbeats slow down, and they cool down below normal. They give up trying to keep their temperature steady, and pass the winter by keeping only just alive. When an animal does this we say it is hibernating, and few mammals really hibernate.

Some of the wild animals of Britain, however, like lizards and snakes, frogs, toads, and newts, are not mammals, and they all hibernate. Lizards and snakes have scaly skins, and are called reptiles; while frogs, toads, and newts never have fur or scales—they have wet, clammy skins, and like wet places; you can read about them in the chapter on pond life.

Reptiles are interesting animals, for at one time there were many more of them than there are now. Some of the reptiles which lived millions of years ago looked terrifying beasts, being covered with great plates of scaly armour. Many of them, though very large, were quite harmless animals, and browsed on the lush, sappy vegetation of the primeval forest. Others, however, were fierce carnivorous monsters which mercilessly hunted and killed their more peaceful relatives.

Then there were flying reptiles whose



The grass-snake (TOP) *is the largest British snake. It is quite harmless to human beings and may be tamed as a pet. The adder* (CENTRE) *is seldom longer than two feet and nearly always has a zigzag line along its back. The slow-worm* (BOTTOM) *is often found in the same sort of country as the adder. It is not a worm or a snake, but a legless lizard, and is quite harmless.*

bat-like wings and scaly bodies made them look frightening indeed. These flying reptiles had no feathers, and were also unlike birds in having teeth, and many years were to pass before birds appeared on the scene.

Not only were there all these land reptiles, but there were others as large or even larger which lived in the seas. The strange thing about all these monsters is that they all died out, no one really knows why, and the only reptiles living today are small animals by comparison.

In hot countries there are turtles and tortoises, crocodiles, snakes, and lizards, but the only reptiles that are native to Britain are snakes and lizards, and all of these, except one, are quite harmless.

For some reason there are no snakes in Ireland, and there are only three kinds in Britain. These are the grass-snake, the adder or viper, and the smooth snake.

HOW SNAKES FEED

All snakes can open their mouths very wide, and because their teeth point backward they are able to grip their victims securely. They do not chew their food, but swallow it whole and then hide away to digest it quietly. Some people believe the stories that are told about frogs who, having been eaten by a grass-snake, are so little harmed that they are able to wriggle back out of the snake's mouth to freedom. Although this is not true, frogs have been found in the stomachs of dead snakes almost unmarked by the reptile's fangs.

None of the snakes has a breastbone, and because their ribs are hinged and move back and forth the animals can use them to move their scales and push themselves along the ground.

Many people are afraid of snakes, but if you pick up a grass-snake you will feel how clean and smooth its dry, scaly skin is. It has small teeth, and even if it tried to bite, it could not hurt you.

WHEN A SNAKE IS ANGRY

Sometimes when you are standing near a hedge you hear a rustling as though a rope is being dragged through the grass. This probably means that a frog has just escaped from a grass-snake, and the snake is hissing with annoyance. Even though grass-snakes are not poisonous, when you pick them up they sometimes try to frighten you by blowing themselves up, hissing, wriggling and even pretending to be dead. If this does not make you let them go, they sometimes give out a horrid-smelling liquid. In spite of this, snakes can be quite easily tamed, and they are sometimes kept as pets.

If you see a snake which is about three feet long and has a yellow-and-black collar behind its head, you can be sure that it is a grass-snake. If it is smaller than this, and has no collar-markings of this kind, then the snake may be an adder—the only poisonous snake found in Britain. Most adders also have a black zigzag line down their backs. Even where they are common, people are seldom bitten. This is because adders, like all snakes, although deaf, lie so flat that they can usually feel your footfalls through the ground from a distance, and they slip quietly away out of danger.

Sometimes people who frighten adders by treading on them by mistake are bitten. Then the snake's hollow fangs pierce the flesh and poison is squirted into the wound. If this happens to anyone, keep him lying down warmly wrapped up and send for a doctor. He will help him to recover quickly, for adder-bites, if properly treated, are not nearly as dangerous as many people think.

The third British snake, the smooth snake, is rather rare, and you are much more likely to see grass-snakes and adders. If you do come across a smooth snake, you will find it as easy to tame as a grass-snake. All three snakes are harmless animals, then, if only they are treated the right way, and because they eat, among other things, voles and mice, they are quite useful, too.

WHAT NO SNAKE CAN DO

Another useful reptile, and one that people kill because they think it is an adder, is the so-called slow-worm. Slow-worms and adders live in the same sort of places, and although the slow-worm is copper-coloured and looks snake-like, if you catch it by its tail it can escape, because it has the power of snapping its tail off and growing a new one. No snake can do this, but all lizards can. A slow-worm is, therefore, not a snake or a worm, but really a lizard that has no legs; it crawls about—sometimes quite quickly—feeding on insect pests, slugs and occasionally worms, so it is a pity to kill it.

Slow-worms are much less like snakes than most people think and differ from them in a number of ways. Like other lizards, and unlike snakes, they can close their eyes when they sleep, for not only do they have upper and lower eyelids, but a third one, too, that flicks backward from the front of each eye. They are unlike snakes, too, in the way they crawl along, for their ribs are fixed to a breastbone so that they cannot use them as snakes do. Instead, they move by wriggling their bodies from side to side.

WHY LIZARDS SELDOM DRINK

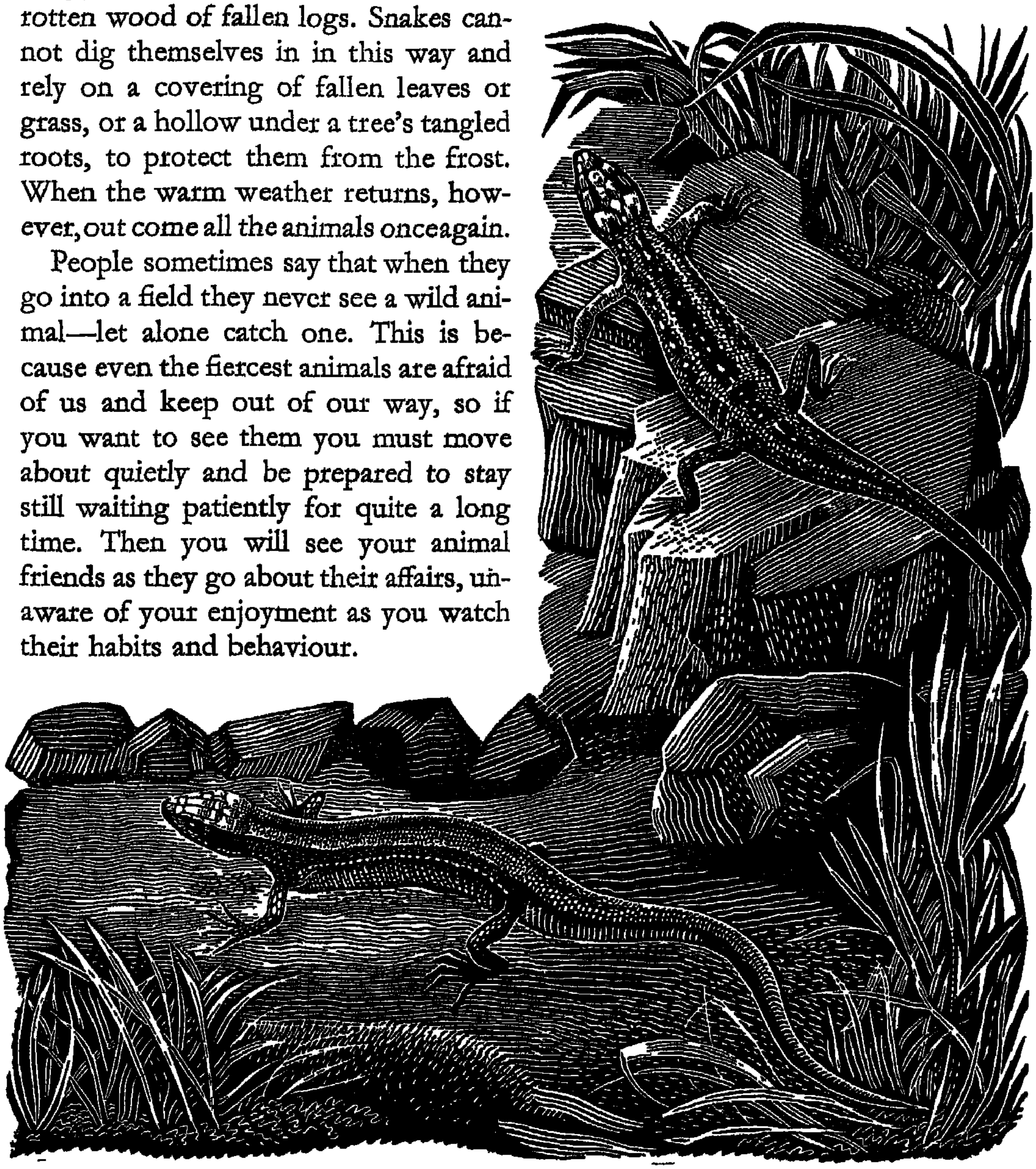
Ordinary lizards and sand-lizards, however, have limbs, and use them for running about. They eat many pests, and are therefore useful animals. Although the sand-lizard is rather rare, and the ordinary lizard is quite common, and though all lizards sometimes drink water, they exist on very little. This is because they obtain much of what they need from the food they eat and, being covered with a tight armour of scales, lose very little of it through their skins.

Lizards can run at a tremendous speed, especially in the hot weather; in fact, the hotter it is the faster they go. So if you see one during the heat of the day you must keep very still, for if you make the slightest move it will be gone in a flash. Lizards are sometimes to be found in the long grass under hedges and by the roadside. If you are quick and can flick the lizard on to the road the strangeness of the smooth road surface seems to confuse it and, instead of making a determined effort to escape, it may even run toward you, so that you can easily catch it. During the cool weather these lively little fellows become sluggish and are easier still to capture.

As the weather becomes cooler in the autumn, lizards and other reptiles prepare for their winter rest. Lizards dig holes in the ground, while slow-worms wriggle into loose soil or into the soft rotten wood of fallen logs. Snakes cannot dig themselves in in this way and rely on a covering of fallen leaves or grass, or a hollow under a tree's tangled roots, to protect them from the frost. When the warm weather returns, however, out come all the animals once again.

People sometimes say that when they go into a field they never see a wild animal—let alone catch one. This is because even the fiercest animals are afraid of us and keep out of our way, so if you want to see them you must move about quietly and be prepared to stay still waiting patiently for quite a long time. Then you will see your animal friends as they go about their affairs, unaware of your enjoyment as you watch their habits and behaviour.

Lizards can move like lightning. Though they may be comparatively slow when the weather is cold, the hotter it becomes the faster they can go. They are timid and any sudden movement sends them scurrying into hiding. They feed on insects. The sand-lizard shown at the top of the drawing is found in some parts of southern England only; it is larger than the common lizard, shown below.



How to know the trees

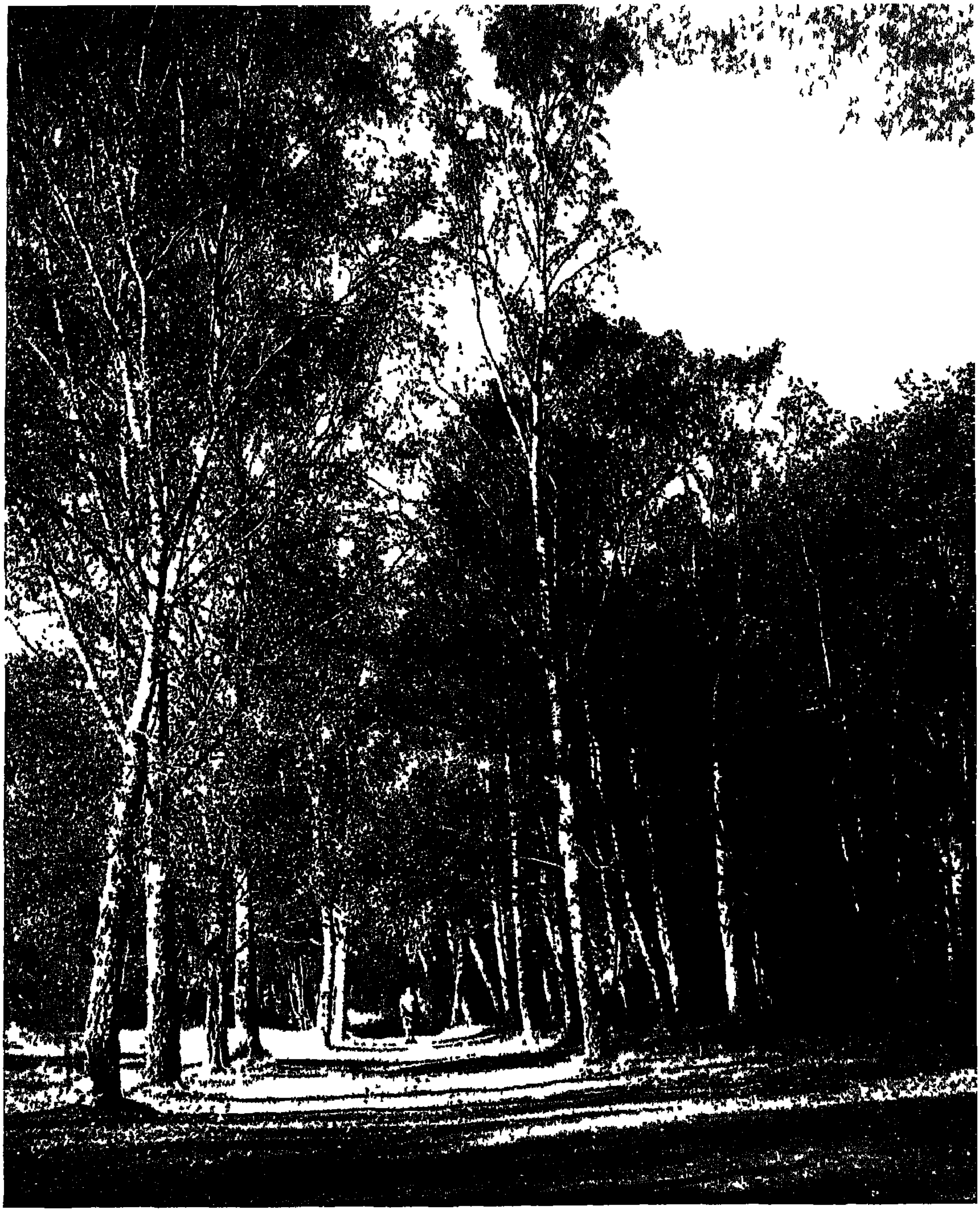
EVERYONE LOVES trees, for they give pleasure to the eye at every season of the year. In summer you enjoy their rich green foliage and may rest under the cool shade of their branches. Even in winter the bare branches are attractive and spectacular against a stormy sky. The bursting buds of spring are heralds of sunny days.

Trees grow in much the same way as we do; but they live a great deal longer and grow much bigger. Like all living things, they breathe and need food. All over the surfaces of the leaves and twigs there are millions of minute pores or mouths, called *stomata*. Through these small mouths passes the oxygen which the trees need to keep them alive. When the tree is active a watery solution called sap is continually drawn up to the leaves from the roots along tiny cells in the woody stem of the trunk and branches. The leaves keep what they want, and the excess of water is sent out into the air in the form of water vapour.

The leaves are the places where, during daylight hours, the food which the tree needs is manufactured. The tree gets its food materials from two sources. The roots obtain moisture and mineral salts from the earth, whilst the tiny mouths on the leaves take in a gas called carbon dioxide from the air. By the aid of energy from the sun and a green substance in the leaves known as chlorophyll, the materials from the earth and air are changed into substances which make the tree grow. The tree needs only the carbon of the carbon dioxide; therefore, the oxygen which it contains is returned to the air.

When we breathe and when fires burn, oxygen of the air is used up and carbon dioxide is made. Trees therefore perform a useful purpose by taking this poisonous gas from the air and restoring the oxygen. The more trees and green plants we have in our towns the purer will be the air we breathe.

Trees, as a general rule, do not like soot and dust, as it blocks up the tiny pores on their leaves and prevents them from breathing. A good heavy rain that washes the leaves clean is welcome to them. Planes and limes are



BIRCH TREES

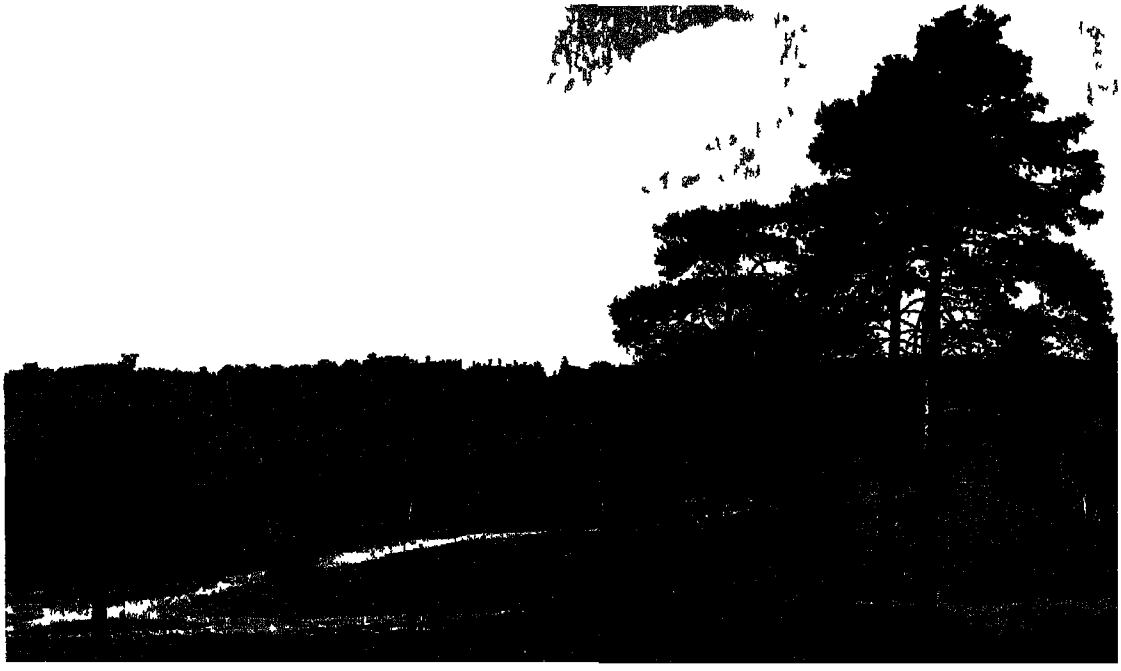
Birch trees are to be found in all parts of Britain, sometimes singly, sometimes forming woods with oak or pine trees, and sometimes (as above*) forming woods of only birch trees. Their graceful, slender trunks are covered with a smooth bark, which stretches as the tree grows, but peels off in thin sheets giving the tree a mottled appearance. The flowers are of two kinds. In spring, when the leaves are still young, the male catkins hanging open emit much powdery pollen. This pollen falls on the small upright female catkins, which then hang downward and change into bunches of tiny winged seeds. Though birch trees are rapid in growth and may attain a height of over fifty feet, they are not very long lived.*

BEECH TREES AND THE ELMS

Beeches thrive in chalky soil When the trees are close together little can grow in their shade In the wood shown above *the trees are spaced far enough apart for plants to grow under them Toadstools are often found near beeches, and their delicate threads, twining round the tree roots, help the tree to feed Elms are common hedgerow trees in England and their spreading leaves provide shade for cattle in summer. The elm in the middle of the picture* below *flowered in February and has long since shed its flaky winged seeds The horse-chestnut tree on the left tells us that the picture was taken in May or June, for it is at that time of year that the tree is gay with blossom*

CONIFERS

High above sea-level beside a mountain tarn are growing tall stately silver fir trees, seen in the top picture They may reach a height of over one hundred feet and live for four hundred years Because they bear flowers in the form of cones they are called conifers and, like most conifers, are evergreens Below *is a plantation of silver firs on sandy soil and on the right in the picture are three Scots pines The silver fir is not a native of Britain but is specially planted To enable it to grow in sandy soil it has been found necessary to add leaf-mould to enable toadstools to grow, since only with a tangle of toadstool threads round their roots can the silver firs feed properly*



CHERRY TREES

There are three common cherry trees native to Britain, the wild cherry, the bird cherry and the gean. The gean is the largest and those shown above *are fine specimens of it. These cherry trees bloom very freely; sometimes the flowers are clustered so thickly on the stems that they appear like white wands in the spring. The fruit, though attractive in colour, is not juicy and sweet like orchard cherries, but pithy and often sour. In the autumn the leaves change colour and become vivid scarlet before they fall. If leafless stems are cut in late winter and put in water indoors, the warmth causes the buds to open. Cherry-tree bark is glossy and darker than birch bark, though it peels off in the same way. The wood is used for making musical instruments, furniture, and cherry-wood pipes.*

the commonest trees found in towns, for they are very hardy and grow quickly. In a very few years a road planted with plane trees becomes a shady avenue.

If you cut through the trunk you will see that the wood is made up of a number of concentric circles. Each year a ring of new wood is added to the growth of the trunk, so that by counting the number of rings you can tell its age. The wood in the centre of the tree is hard and dead. The living part of the tree, where a new layer of soft wood is being made, is just under the bark or outer skin. The bark protects the living cells from severe weather, and if you peel off the bark and cut into the soft wood, the tree will die.

HOW LONG TREES LIVE

When trees are to be felled, the woodman often cuts a V-shaped ring with his axe round the base of the trunks. This cuts off the sap so that it cannot rise in the spring. The trees are then chopped down and the dry wood used for building. In young plantations rabbits will do much damage by biting through the bark during the winter months, and wire-netting has to be used to protect the trees until they are too large for the rabbits to injure.

How long a tree will live depends on the kind of tree. The English oak is one of the oldest forest trees. It may live for seven hundred years or more. A good oak is worth several hundred pounds.

When you compare the long life of trees with that of animals you have to remember that the greater part of a tree consists of sapless and lifeless wood. An animal cannot get a new heart to replace a worn-out one, but when a tree sheds its old leaves it gets a new start in life with the fresh leaves in spring. That is one of the reasons why some kinds of trees have such long lives.

HOW TREES HELP ANIMALS

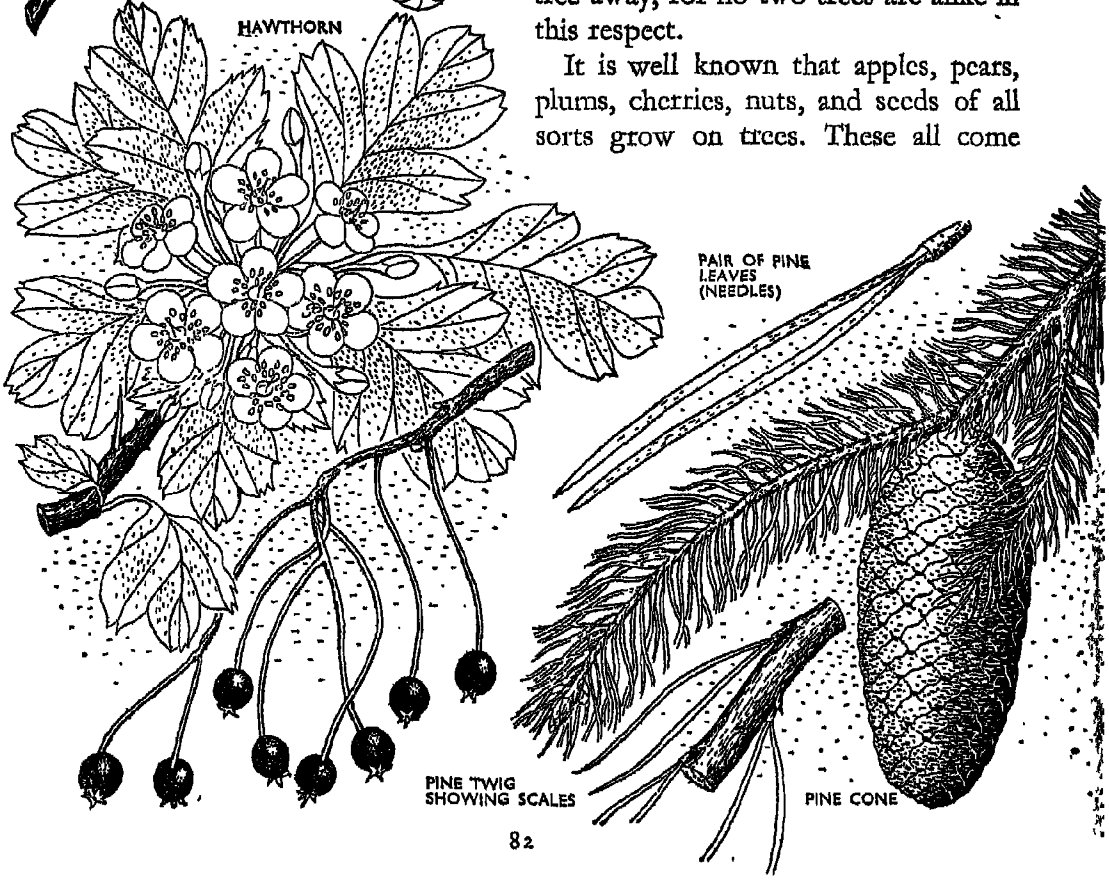
In parts of the country, on hillsides and places where the soil is not rich enough for farming, you often see plantations of young trees. Most of them are quick-growing, like firs and larches. Foresters plant hundreds of thousands of these trees each year. As the young trees get bigger, the foresters thin them out and sell the trunks for pit-props and poles. There is a society called The Men of the Trees, whose members are not only tree-lovers, but do all they can to preserve the woodlands of Great Britain. They try to stop people from cutting down trees unnecessarily, and encourage them to plant new ones when old ones are removed.

Trees provide shelter and a source of food for birds and insects, they afford a retreat for cattle from the wind and the sun, and they have a great influence on the climate and the air we breathe. They help, too, in making a fertile soil for the farmer to grow his crops. At one time there was a rich valley in America which became a dusty desert. The people who lived there chopped down all the trees; then the sun baked the earth to powdery dust and the wind carried it away in dust-storms. Now the American Government is spending a lot of money to restore the land from a desert to a fertile place so that people can once more get a living there.

A walk in a park or in the country is all the more interesting if you can tell the names of the common trees. In summer the easiest way of recognizing them is by the leaves, whilst the flowers, if any, and the bark may help. In winter and spring the twigs with their buds are your guide for recognizing trees, whilst the flowers, the general shape and arrangement of the bare branches are different for each tree.

Some trees are easy to pick out, whilst others are so nearly alike that you may find it difficult to decide. The resting buds, however, always give the tree away, for no two trees are alike in this respect.

It is well known that apples, pears, plums, cherries, nuts, and seeds of all sorts grow on trees. These all come



from flowers. In spring you may have seen an orchard in full blossom and have admired the beautiful white and pinkish petals of the flowers. As a general rule, the flowers of common trees are not so noticeable; in fact, some people have never seen them at all, for brightly coloured petals and green sepals, or seed-pod leaves, are often missing.

On many trees the flowers appear very early in the year, before the leaves. They are very small, and grow in bunches or on tassels known as catkins. It is common for the catkins to dangle downward, but some stand erect. On some trees you will find perfect flowers with sepals, petals, stamens, and seed-boxes. In other cases you will find only stamens and seed-boxes, and instead of petals there are small scale-leaves. Another interesting thing about the flowers of trees is that there are two kinds. One kind contains only seed-boxes, whilst the other kind is made up entirely of stamens.

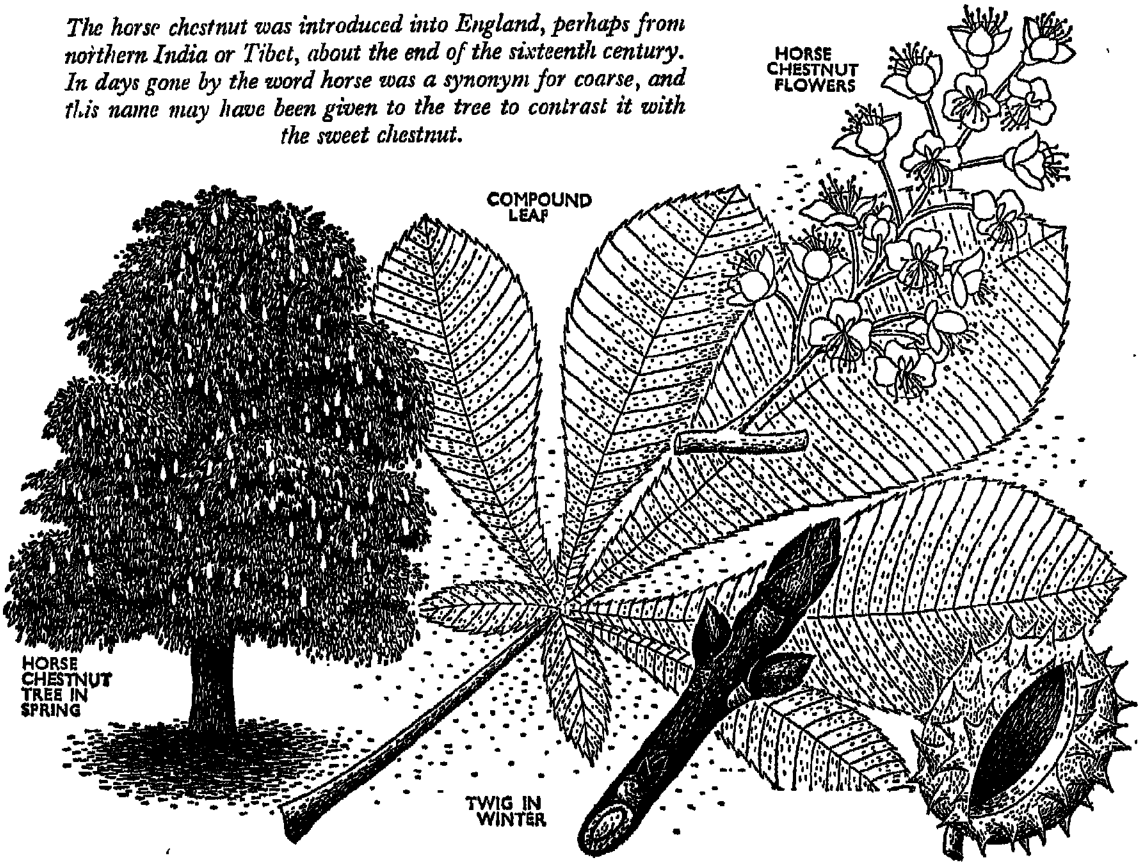
CONE OF SILVER FIR
FIR
SILVER FIR TWIG SHOWING SCALES AND LEAVES

The stamen-flowers with their bags of pollen are called males. When they have shed their pollen the flowers fall off. The seed-flowers are females. When they have been fertilized they grow bigger and produce seeds. Sometimes you will find male and female catkins close together on the same twig, as is the case with the oak tree. In other cases only female catkins are found on one tree, and near it there will be another tree with only male flowers. Along a country lane you will find male and female willow trees. The males, pussy-willows with heads of yellow pollen, are the ones which people pick around Easter-time.

Do not forget that it takes both kinds of flower to make a fertile seed. In the case of trees, the strong winds in the early part of the year, as well as insects and bees, carry the pollen from the male flowers to the seed-vessels of the females which are ready to receive it.

No doubt you have noticed that with the approach of autumn, and the cold, frosty days, many of the leaves on trees begin to change colour. The beautiful autumn tints of yellow, brown, and shades of orange and red give the woodlands a last blaze of colour before the trees take their winter sleep. Trees which shed all their leaves in the autumn of each year are called deciduous.

Before the leaves fall, a thin, corky skin begins to grow through the base of each leaf-stalk. As it grows slowly inward the flow of sap to the leaf is



The horse chestnut was introduced into England, perhaps from northern India or Tibet, about the end of the sixteenth century. In days gone by the word horse was a synonym for coarse, and this name may have been given to the tree to contrast it with the sweet chestnut.

gradually cut off—something like turning off the water-tap. When the skin has formed right through, the leaf begins to die, and the changing colours are brought about by the decay which sets in. For a while the leaf clings to the twig, but sooner or later frost, heavy rain or strong winds will bring the leaves scurrying down. When the leaf has fallen, a nice clean leaf-scar marks the place where the stalk joined the twig, and just above it is the winter bud of next year's leaf.

If you pull a leaf off in summer you make a wound, but each autumn Nature performs a piece of up-to-date surgery by healing a wound before the small limb of the leaf-stalk is severed from the twig. A bough of a tree broken off in summer still retains its withered leaves in winter because no skin has grown to sever them.

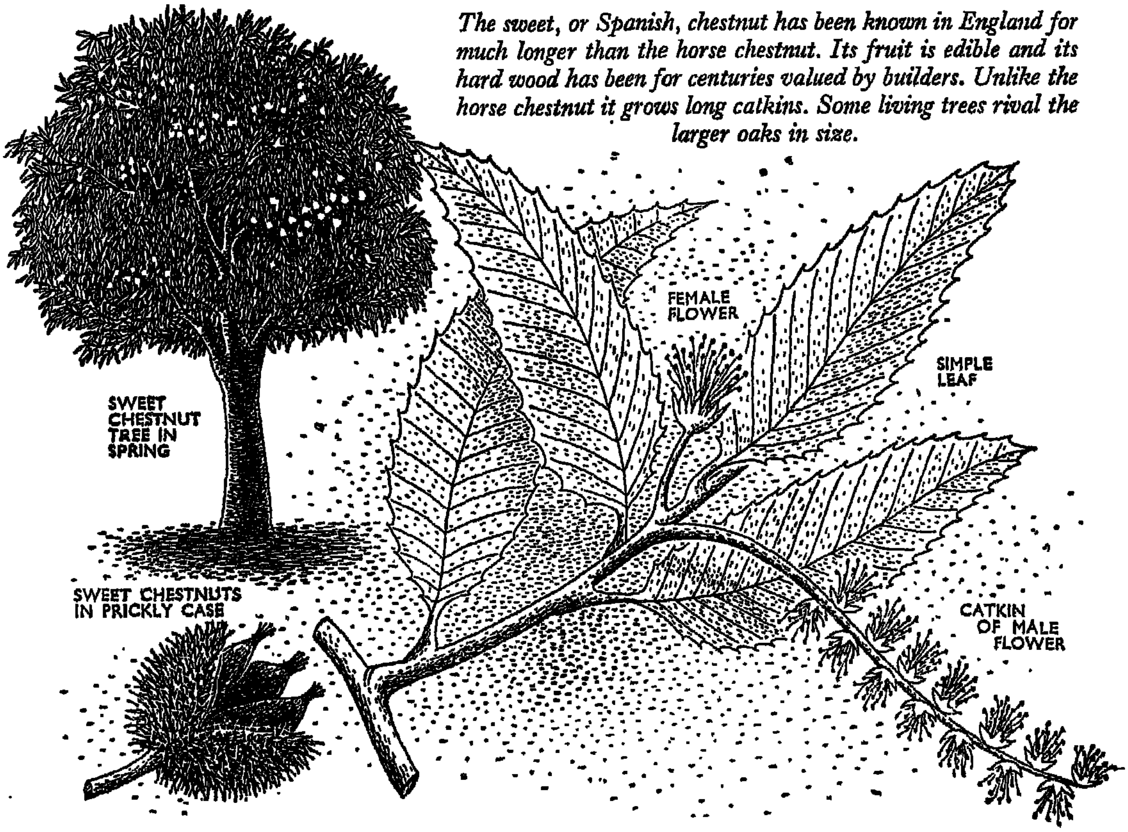
When the flowers of deciduous trees are over, seed-boxes are formed. Sometimes these seed-boxes take the form of berries in which the seeds are surrounded by a juicy or mealy material. Sometimes nuts are formed, or there may be only dry seed-boxes provided with papery wings or downy hairs, so that they can be carried away by the wind to germinate and, on fresh soil, grow into new trees. Around an oak tree or under a horse chestnut you will often find young trees struggling hard to grow because they have not been so fortunate as to be carried far enough away from the parent tree.

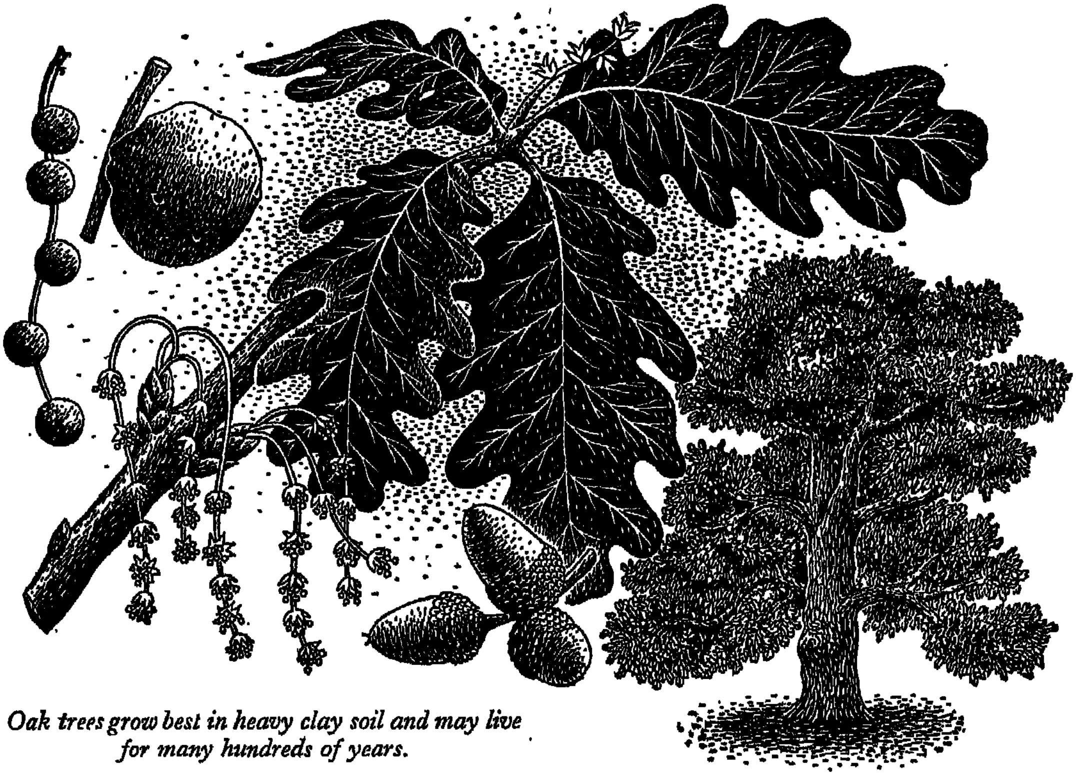
Among the flowering trees which shed their leaves annually there are a few exceptions which retain their leaves through the winter. The holly and laurels are good examples, and these trees are called evergreens. If you examine their leaves you will find that they are smooth, tough and leathery, to resist the cold weather. The surface, too, has a waxy covering which makes them waterproof, so that snow or rain does not stay on to rot them.

Now let us look at a few deciduous trees and learn something about them. Trees which produce nuts make a ready appeal; the oak is probably most popular and comes first to mind. It is the king of the forest, full of dignity in summer, and is strong to resist the gales of winter. In Saxon times Britain had dense oak-forests, and herds of pigs fed on the acorns. The oak tree is broad and spreading and, in shape, fits roughly into a square. The leaves appear early in May, pale reddish-green at first, changing to dark glossy green. They are feather-shaped, and the edges are deeply lobed.

The flowers come out about the same time. On the same twig you will find two kinds of catkin. The slender one, which hangs down, has pollen (male)

The sweet, or Spanish, chestnut has been known in England for much longer than the horse chestnut. Its fruit is edible and its hard wood has been for centuries valued by builders. Unlike the horse chestnut it grows long catkins. Some living trees rival the larger oaks in size.


SWEET CHESTNUT TREE IN SPRING
FEMALE FLOWER
SIMPLE LEAF
SWEET CHESTNUTS IN PRICKLY CASE
CATKIN OF MALE FLOWER



Oak trees grow best in heavy clay soil and may live for many hundreds of years.

flowers with bunches of yellow-headed stamens. The stouter one, which stands upright, has seed (female) flowers. In each tiny green cup there is a seed-box with three tiny stigmas, or receptacles for the pollen, on the crown. Later in the year some of these seed-vessels will grow into acorns. Each acorn rests firmly in its cup, until it becomes ripe and falls to the ground.

Several kinds of gall are found on the tree. These are the homes of insects. One kind is built along a hanging catkin, and looks like a string of beads. In each "bead" there is a tiny grub which will change into a fly. Another large spongy gall, pinkish-brown in colour, is called an oak-apple.

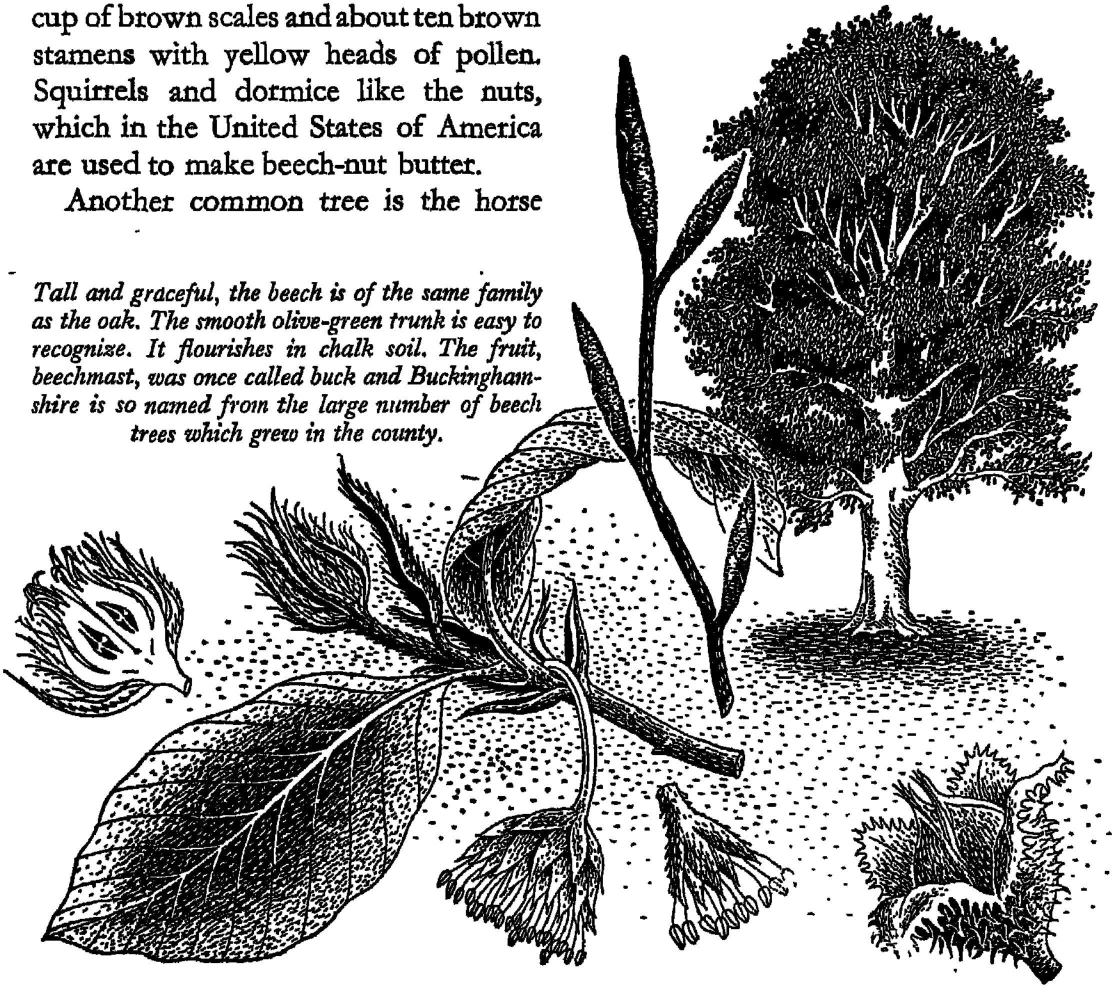
In winter you will notice that the rough, dark trunk is broad and spreading at the base. Heavy, twisted branches with round elbows spread outward. The winter buds are blunt and irregular, and you will find a cluster of them at the end of a twig. The tree grows slowly, and the wood is hard and close-grained.

Next in importance to the oak is the beech. It is a tall and beautiful tree with wide, spreading branches. You can easily recognize its smooth, olive-green trunk. The leaves are a deep glossy green, with clearly marked veins running from the centre to the edge. They are crowded so closely that they make a perfect shade on a sunny day. The autumn-tinted leaves are a lovely golden-orange colour, and in sheltered places they stay on the tree until the spring buds push them off.

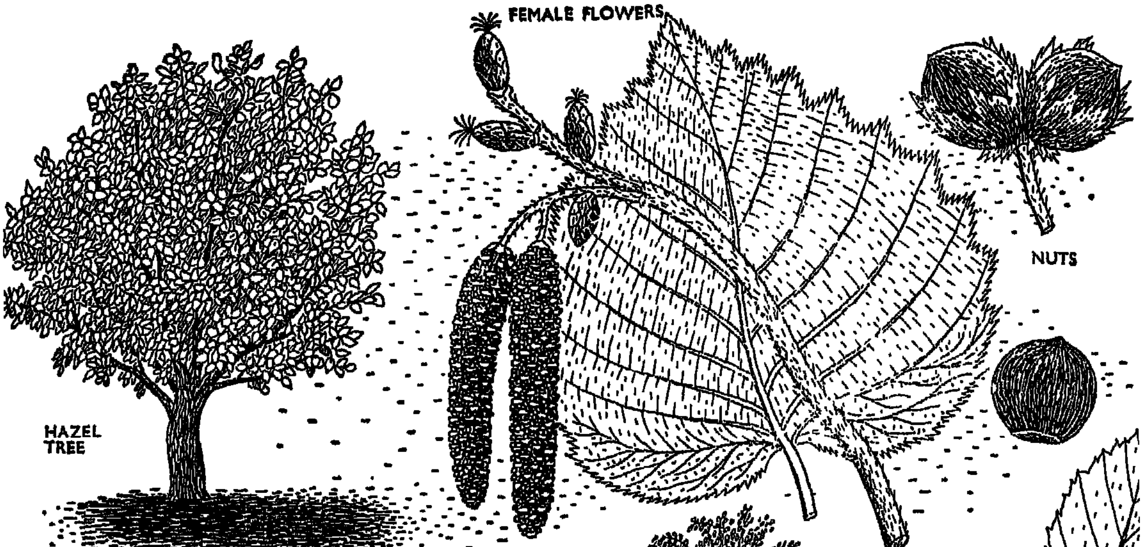
The winter buds are long and pointed, like miniature cigars. Two kinds of flower appear on the same twig about the same time as the leaves. The seed-flowers are upright on stiff stalks. They look like bristly balls with six slender threads protruding from each ball. Inside there are two seed-boxes. When they are ripe you get a prickly, four-sided cup with two triangular beech-nuts inside. The stamen-flowers are on long, drooping stalks. The flower is a cup of brown scales and about ten brown stamens with yellow heads of pollen. Squirrels and dormice like the nuts, which in the United States of America are used to make beech-nut butter.

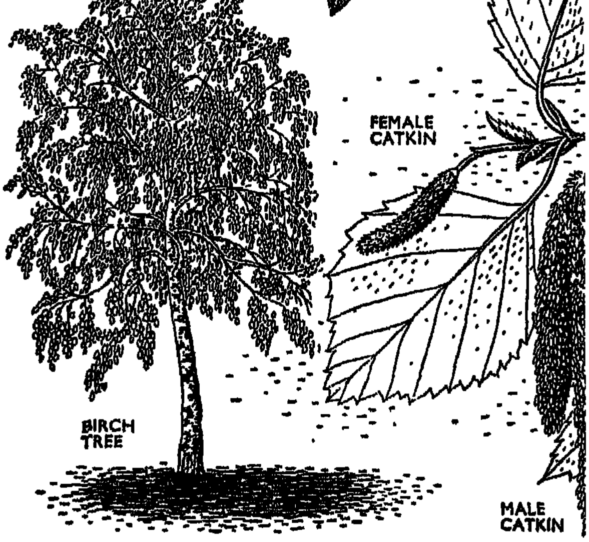
Another common tree is the horse chestnut. The stout trunk has a rough, scaly bark, and the branches spread outward with their tips curling upward. Along the twigs in winter are pairs of large brown, sticky buds. Under each bud is a scar in the shape of a horseshoe where last year's leaf-stalk joined the twig.

In April the buds swell, the scales are pushed back, and a pale-green leaf made up of seven leaflets appears. At first it hangs down like a half-open umbrella.



Tall and graceful, the beech is of the same family as the oak. The smooth olive-green trunk is easy to recognize. It flourishes in chalk soil. The fruit, beechmast, was once called buck and Buckinghamshire is so named from the large number of beech trees which grew in the county.





The warm sun soon makes it spread out flat.

The big spikes of white or pink flowers appear in May. They are sometimes called Roman candles, or giant's nosegay. The lowest flowers on the spike are perfect, having five green sepals, five white petals, seven stamens and a seed-box. The upper flowers have no seed-boxes. Some of the lower flowers, when fertilized, become round, spiky balls. When ripe, the ball splits open and a large, shiny, dark-brown nut rolls out. The nuts are bitter, but cattle and sheep will eat them. Probably you would find the sweet chestnut more to your liking. This tree grows best in warm countries like Italy and Spain, but is also to be found in Britain. It is a tall, bushy tree, and the deep ridges on the trunk twist round like the strands of a rope. Each long, oval, glossy leaf has straight veins running from the centre to the toothed edge.

You will find two kinds of flower among the leaves in May or June. A long, stiff catkin pointing outward contains the pollen-flowers. In little green cups along the stalk, yellow-headed stamens peep out. Next to the pollen-catkin, and pointing upward like a paintbrush, is the seed-catkin, with bristly stigmas at the top. The seed grows into a large, prickly ball with two or three nuts inside. Baked chestnuts are delicious. They are often boiled like potatoes or ground into flour for pastry.

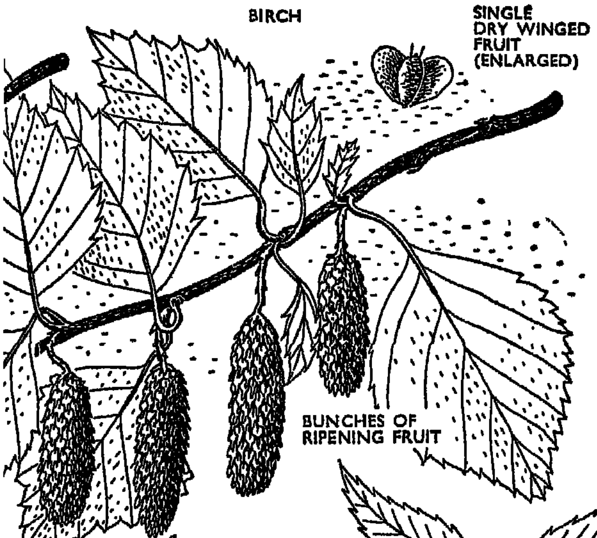
Hazelnuts are gathered in the early

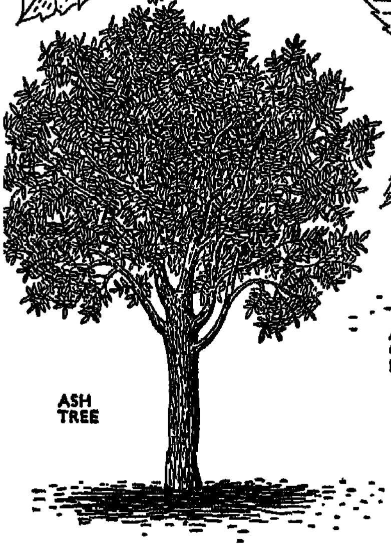
autumn. The hazel is usually seen as a large bush in hedges and woodland places, but it can grow into a tall tree. The tree is easy to recognize, for even at Christmas-time along the twigs, with their tight little winter buds, groups of long brown male catkins, known as lambs' tails, dangle in the wind.

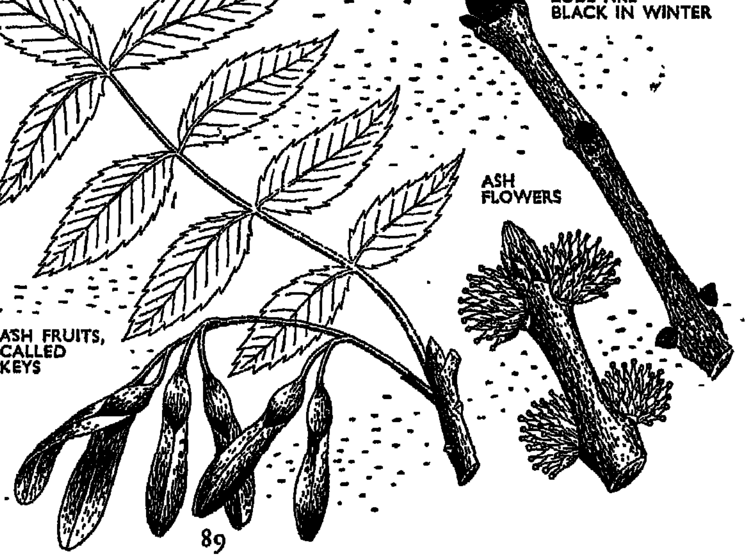
Early in the year the scales of the flowers open and eight bags of yellow pollen send out puffs of yellow dust from each flower. The seed-catkins are very small. They look like tiny buds with crimson threads peeping out. The threads are the stigmas of the seeds. Each seed rests in a green frill which becomes the cup of the nut. The clusters of green nuts turn brown when ripe.

The leaves are in two rows along the twigs. The twigs and branches are tough and elastic. Did you know that the rod which a diviner uses when searching for water is usually a hazel twig? Squirrels and a bird called the nuthatch are as fond of the nuts as human beings are.

Now let us have a look at trees with winged seeds. Everyone loves the birch tree because it is so dainty and fairy-like, yet it is hardy enough to grow in cold countries like Lapland. You can recognize it by its silvery-white bark, which peels off easily. The bark is so tough that only fire seems able to destroy it. The Red Indians used it to cover their canoes. Twisted pieces


BIRCH
SINGLE DRY WINGED FRUIT (ENLARGED)
BUNCHES OF RIPENING FRUIT





of bark make good torches, and sweet-smelling russia leather is tanned with it. Sometimes you see on the tree a ball of twigs like a bird's nest. It is known as a "witch's broom," and is made by an insect.

In April appear tiny, oval-shaped leaves with small and large teeth along the edges. Pairs of pollen-catkins are at the end of a twig, whilst a single, fatter and rounder seed-catkin is farther back. In May the flowers open, and the pollen-catkins look like yellow caterpillars. There are three pairs of stamens behind each scale-leaf, and clouds of yellow pollen are shaken out. The seed-flowers have three seeds behind their scales, and when ripe they form small nuts with two wings in the shape of leaves.

QUEEN OF THE FOREST

Did you know that the ash is called the queen of the forest? Its branches are straighter than those of the oak and are pale grey in colour. The bark of an old tree is cracked into wavy ridges. In winter you cannot mistake the tree, for the resting buds are jet black, velvety and in pairs, with an end bud like the Ace of Spades. In a poem by Tennyson you will find the words: "Black as ash-buds in the month of March."

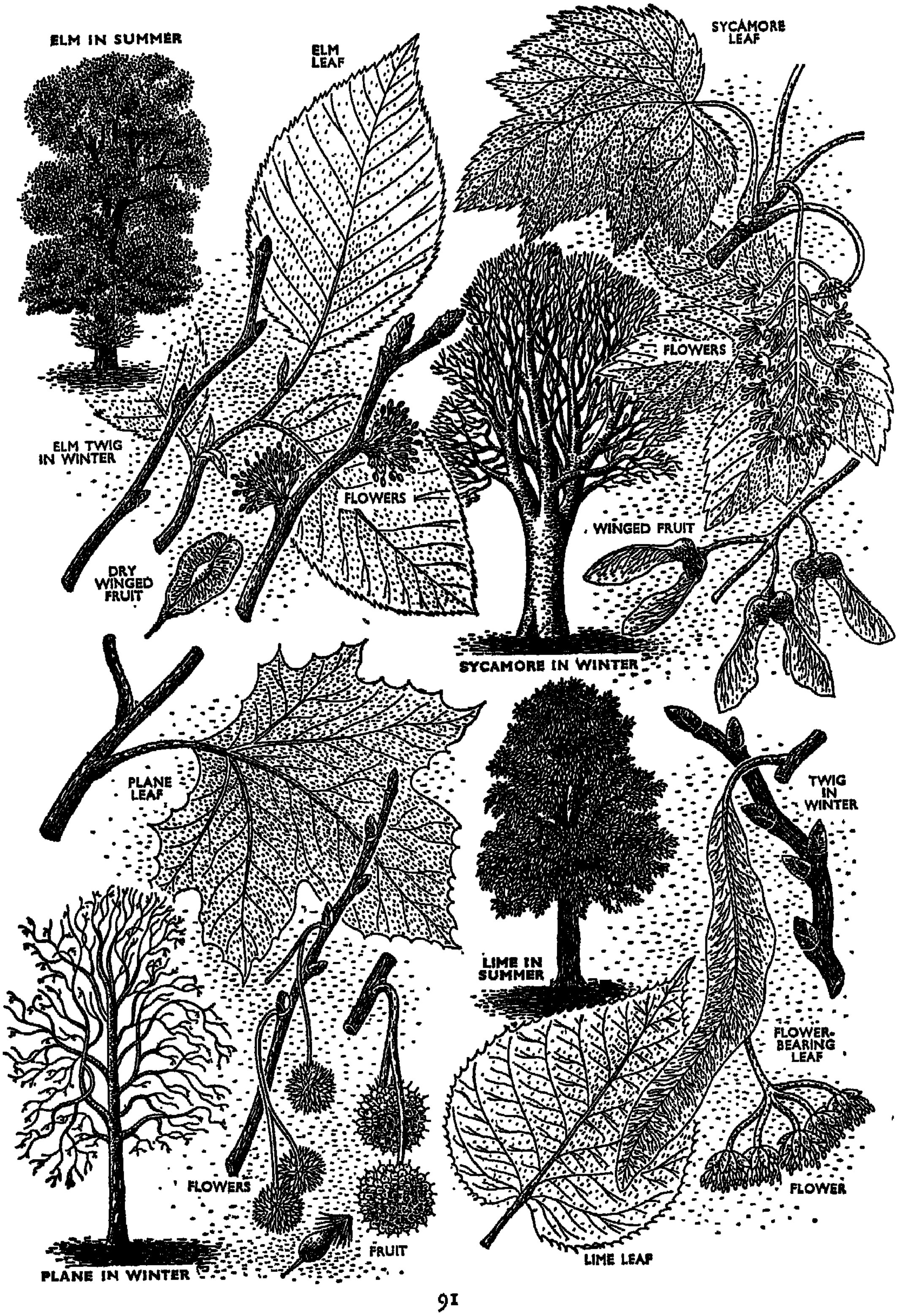
The tiny flowers are in bunches around the twigs, and come out before the leaves. They have no sepals or petals, only a green, bottle-shaped seed-vessel and two stamens with bags of purple pollen. Later the seeds get long, flat wings and hang down like bunches of keys. Each leaf is made up of pairs of leaflets like lances with toothed edges. Years ago the ash tree was supposed to have magic powers for curing all kinds of illnesses.

The elm is one of the tallest trees to be found in Great Britain. It has a dark, rugged bark with deep furrows. The huge upper branches make it look top-heavy. You can pick out an old tree by the cluster of small branches low down near the ground. It is not wise to shelter under an elm in stormy weather, for the heavy branches are apt to snap without warning.

The winter buds are fat and pointed and sit on little shelves. Very early in the year the twigs up above bear many scaly buds like beads. In March they burst open and bunches of flowers with red stamens and purple heads appear. Each flower has a four-lipped cup holding five stamens and an oval seed-box. When the flower dies, seeds with wings as thin as paper are formed, and these are being blown away almost before the leaves are out. The leaf-buds are pink, and the open leaf is small and narrow, with uneven teeth along the edge.

PROPELLER-LIKE SEEDS

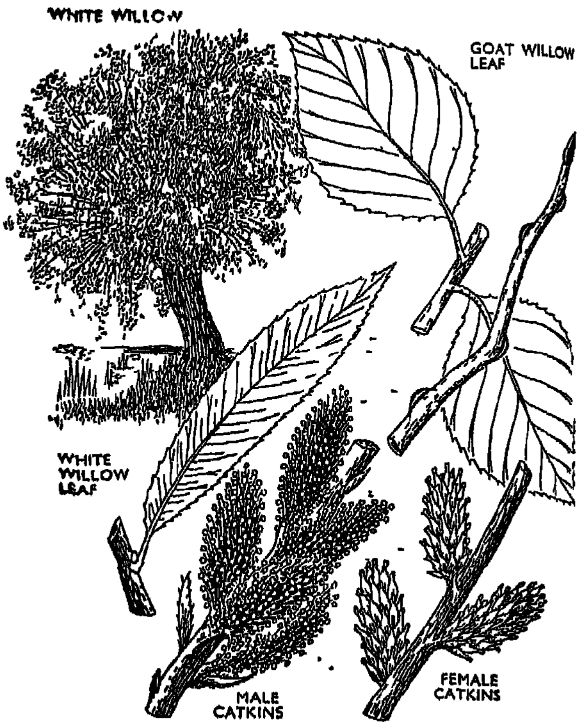
Have you ever thrown into the air a winged seed of the sycamore to see it come spinning down like a propeller? The sycamore should be called the great maple. It is a big, heavy tree which has V-shaped branches and a bark which peels off in patches. The winter buds are egg-shaped and in pairs, and often there is no terminal bud. When the buds open in May, five-fingered leaves with toothed edges slowly unfold. The leaf-stalk is reddish in colour. The leaves


ELM IN SUMMER
ELM LEAF
SYCAMORE LEAF
FLOWERS
ELM TWIG IN WINTER
FLOWERS
WINGED FRUIT
DRY WINGED FRUIT
SYCAMORE IN WINTER
PLANE LEAF
TWIG IN WINTER
LIME IN SUMMER
FLOWER-BEARING LEAF
FLOWERS
FLOWER
FRUIT
LIME LEAF
PLANE IN WINTER

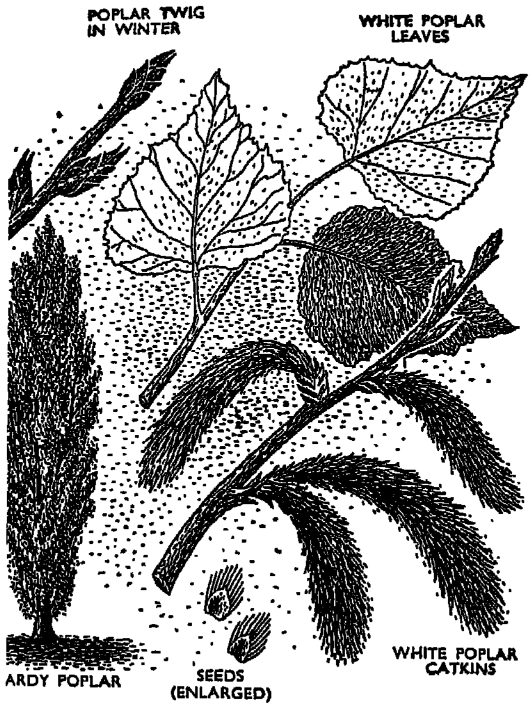
grow in pairs and get smaller toward the end of a twig.

The flowers appear with the leaves. They grow on long tassels. You will find that some of the flowers in a tassel are perfect, whilst others are stamen- or seed-flowers only. Each perfect flower has about five narrow sepals, five yellowish-green petals, a ring of stamens and a seed-box with two curved stigmas. Later two seeds are formed with wings shaped like the letter U. In Scotland, years ago, they used to hang people on the sycamore tree, and for this reason it is often called the "tree *of mourning*."

If you live in a town you will easily recognize avenues of the plane. This tree has a smooth bark which peels off in yellowish-green patches. Although it has no winged seeds, it is often mistaken for the sycamore. The leaves, although alike, are arranged alternately on the twigs. The stalk is green, and the end forms a kind of cup under which you will find the winter bud, which is hidden until the leaf falls. Hanging on the bare branches in winter are strings of large, prickly seed-balls. Early in spring you will see the new catkins. A string of tiny green balls contains bunches of purple stamens. Near it, on another string, will be seed-vessels. On the soft centre of each ball are seed-boxes with pointed stigmas sticking out like pins in a round cushion. The seeds ripen and turn dark brown. When next spring arrives they burst open and the dry seeds fall to the ground.



In Berlin there is an avenue called Unter den Linden, which means "Under the Limes." The lime, however, is wrongly named. Its real name is line or linden. It is a tall, handsome tree and grows well in the smoky towns of Britain. Its bark is rough and dark and there are often young shoots around the base. The small, oval winter buds have red scale-leaves that litter the ground when the emerald-green leaves unfold in May. The leaves are pointed and shaped like a lopsided heart. They are very thin, and the first frost brings them down. When the flowers open in June you can hear the buzzing of bees gathering the rich nectar. The flowers hang down in a cluster at the end of a long stalk. Attached to the stalk is a pale-yellow wing, called a bract. The flowers have five green sepals, five pale-green petals, a ring of yellow stamens



and a pea-shaped seed-box. Later on, a cluster of ball-shaped seeds will be carried away by the wind.

Now we come to trees with downy seeds, such as the willow. There are many kinds of willow, but white willow and the goat, or sallow, willow are the best known. The white willow is the largest. Look for it along the banks of a river, with its long, silvery-grey leaves. The goat willow, with its broad, oval leaves, is more often found as a bush in hedges, along roadsides or in woods. Before the leaves open the winter buds look like tiny mice creeping along the slender branches.

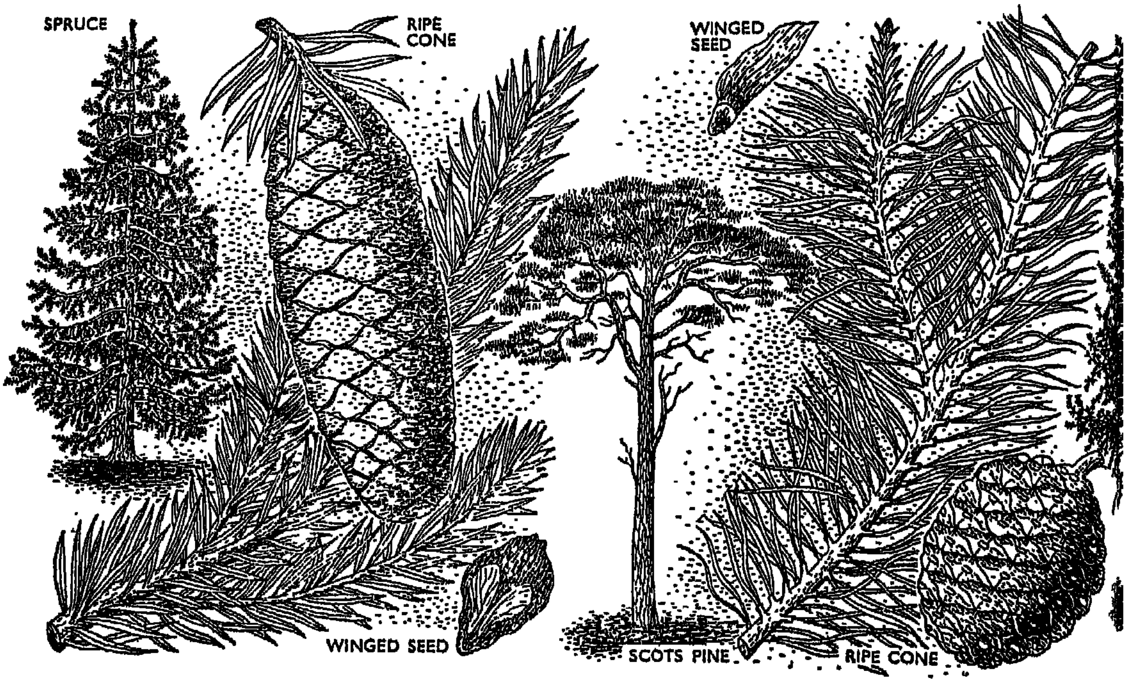
About Easter-time two kinds of catkin appear on separate trees. The pollen or "pussy" catkins, with their fluffy yellow heads, are the prettiest of all catkins. They are often worn by church-going people on Palm Sunday. At first the catkins are covered with grey, silky down. When the scales open you see two yellow-headed *stamens* with, below, a honey-gland which attracts the bees.

The seed-catkins, on another tree, are stiffer and greener. They contain only pear-shaped seed-boxes. When ripe, the seeds with silky hairs strew the ground with a substance closely resembling cotton wool.

Does the willow remind you of cricket and summer days? This may be because cricket-bats are made of wood from the willow tree, and so the tree is associated with the game.

Another tree which is easy to recognize is the poplar. These tall-growing trees like to live in damp places. The white, the black and the Lombardy are common poplars. You cannot mistake the Lombardy, for its branches cling to the trunk and it shoots up like a church steeple. The leaves of the white poplar are dark green on the upper surface and silvery-white underneath. They are triangular in shape and are always quivering. The winter buds are sharp-pointed, like the beak of a bird. Although common in Britain, the black poplar is even more widespread in Central and Southern Europe and parts of Asia.

In March two kinds of flower appear on separate trees. The long, woolly tails of the pollen-catkins are red in colour. When the flowers open you see a bunch of purple *stamens on a round* platform. The withered catkins fall to the ground like a crowd of wiggly



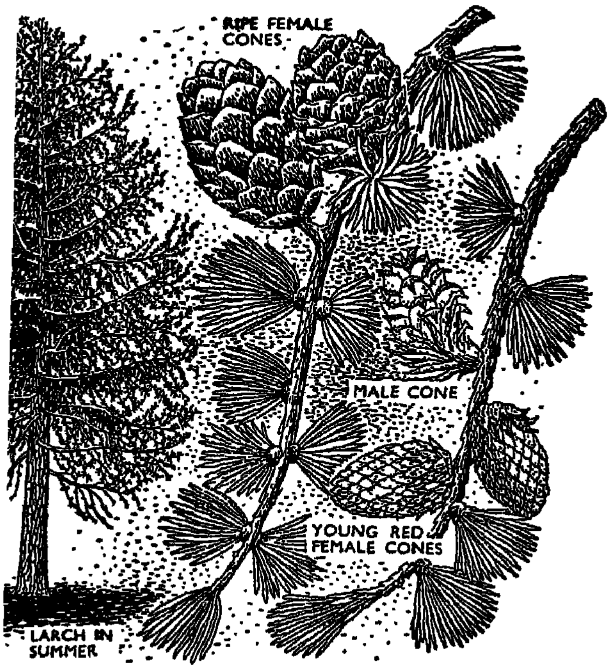
caterpillars. The seed-catkins on another tree are stouter and fatter. Each flower has a green seed-box in a small green cup. The ripe seeds are carried away by the wind in a downy covering of silky hairs.

Some trees have berries which are good to eat; but you would not like the taste of holly berries. The holly, or holm-tree, is the best-known evergreen. The prickly oval leaves hang on the tree for several years. On young twigs the new leaves have no spines. It is a slow-growing tree, and is often used for making a thick hedge.

The flowers appear in May in crowded bunches along the twigs. Each flower is pinkish on the outside and white within. There is a cup of four sepals, a long white tube opening out to four petals, four yellow stamens and a seed-box. Not all the flowers are perfect, some contain only pollen, others seed. The ripening seeds change to green and then red berries with four seeds inside a mealy pulp that birds love to eat. Holly decorations are used to brighten up our homes at Christmastime.

The hawthorn, also known as may or white thorn, is another flowering tree on our list. This bushy tree is used a great deal for making the lovely hedges of Britain's countryside. In May it is a mass of sweet-smelling, white flowers. On May Day the maypole and the dancers are decorated with garlands of the blossoms. The small, red, glossy fruits, which are called haws, provide food for birds during the winter when the ground is frozen or covered with snow.

The young leaves appear as pale-green beads. They open into glossy-green leaves cut up into blunt fingers. In May the flowers, looking like tiny



snowballs, appear in clusters at the end of a green stalk. Each open flower has five pointed sepals, five white petals, a ring of stamens with pink heads and a seed-box below. The seed-boxes change to a bunch of berries, first green and then red or crimson. They are called haws, and in winter birds feed on the mealy pulp.

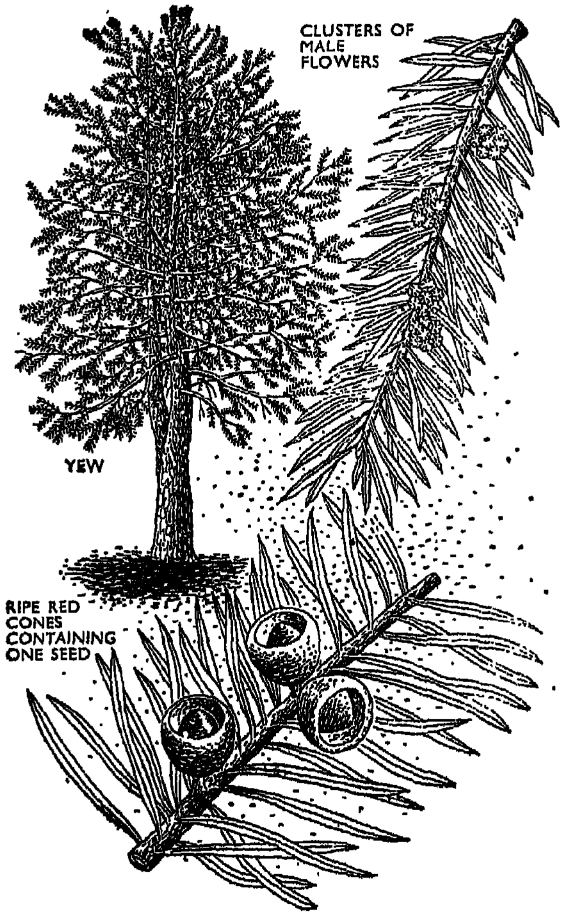
The first thing you notice about fir and pine trees, which are known as conifers, is that they are conical in shape. The branches stand out like spokes in a wheel, and the leaves are often needle-shaped. Behind brown scales on the twigs are short shoots from which the leaves grow. Pines have leaves in pairs, and the cones are egg-shaped and woody. Firs have single leaves, and the cones are usually round and have thin, glossy scales. The flower-catkins of both trees are very much alike, and one description might do for all of them. The scales of young catkins are coloured pink or red. The pollen-catkins grow from short shoots instead of leaves. Two pollen-bags are underneath each scale and, when ripe, yellow pollen dust is carried by the wind to seed-flowers. Seed-catkins on side buds have their naked seeds on the upper surface of each scale. When fertilized, the seed-cone closes up. The following summer it is bigger and the scales are woody. When ripe it opens and the winged seeds are blown away.

During the winter months, when most of the trees are bare, you will have a chance to notice all the many shades of green among the large variety of conifers.

The fir you will recognize quickly is the spruce fir, because Christmas trees are young spruce firs. They grow to very tall trees and make dense forests. The bark is scaly and reddish-brown. The evergreen leaves are short and flat. Two kinds of flower appear in May or June. Small pink stamen-catkins are on the last year's twigs, and seed-cones are on this year's shoots. The brown cones are about six inches long, and hang down.

The most popular of all the pine trees is the Scots pine, which grows irregular in shape as it gets older, spreading out at the top. The reddish bark is tough and furrowed. Notice the pairs of needle-shaped leaves. The flowers are very similar to those of the spruce fir, but the cones are egg-shaped and woody. Tapped trees supply us with turpentine and resin.

The yew tree, which is common in


CLUSTERS OF MALE FLOWERS
YEW
RIPE RED CONES CONTAINING ONE SEED

churchyards, grows slowly and lives for centuries. Its narrow leaves are poisonous to cattle, and the two kinds of flower are on separate trees. The cone may surprise you, for it is a red, waxy-looking cup with a seed in the centre.

In winter a plantation of larch trees looks quite dead, for, unlike other conifers, the larch sheds its leaves each year. In early spring it comes alive with tufts of bright-green leaves and rosy-red flowers. Larches grow in bleak places, and the branches bend down like a roof, so that snow slides off easily. Plantations are made on barren land. Two kinds of flower are on the same twig, and the rosy-red seed-catkins change into hard, woody cones that stay on the tree after the winged seeds have gone.

The wood of trees has provided man with one of the most useful materials for building and for an infinite variety of other purposes. Wherever you look you find articles made of wood, and in every case the choice of wood depends on the purpose the article is to serve. You will see from what has already been said that there is a considerable variety of trees, each producing widely differing woods. These woods, as we mentioned earlier, are known as either *hard*—which are obtained from slow-growing trees—or *soft*, from quick-growing trees.

Hard woods are used when considerable strength and resistance to wear are essential, whilst soft woods have the advantage that they can be easily worked by hand.

Among the hard woods, oak is probably the most common, being widely used in constructional work and for making furniture. You see some fine oak rafters in old houses, and in the time of Queen Elizabeth the ships of Britain were built largely of oak.

Soft woods are of great use in the building of modern homes for such things as floorboards, rafters, doors and window-frames. They also have a number of specialized applications, according to their qualities.

These are, of course, only a few of the main purposes for which wood is used. No doubt you will be able to think of others in everyday life.

Wild flowers of Britain

If someone asked you "What is the difference between a flower and a plant?" could you give the answer? Most people would say that they were the same thing, until they found out that there were two kinds of plants—those with flowers and those that never have them.

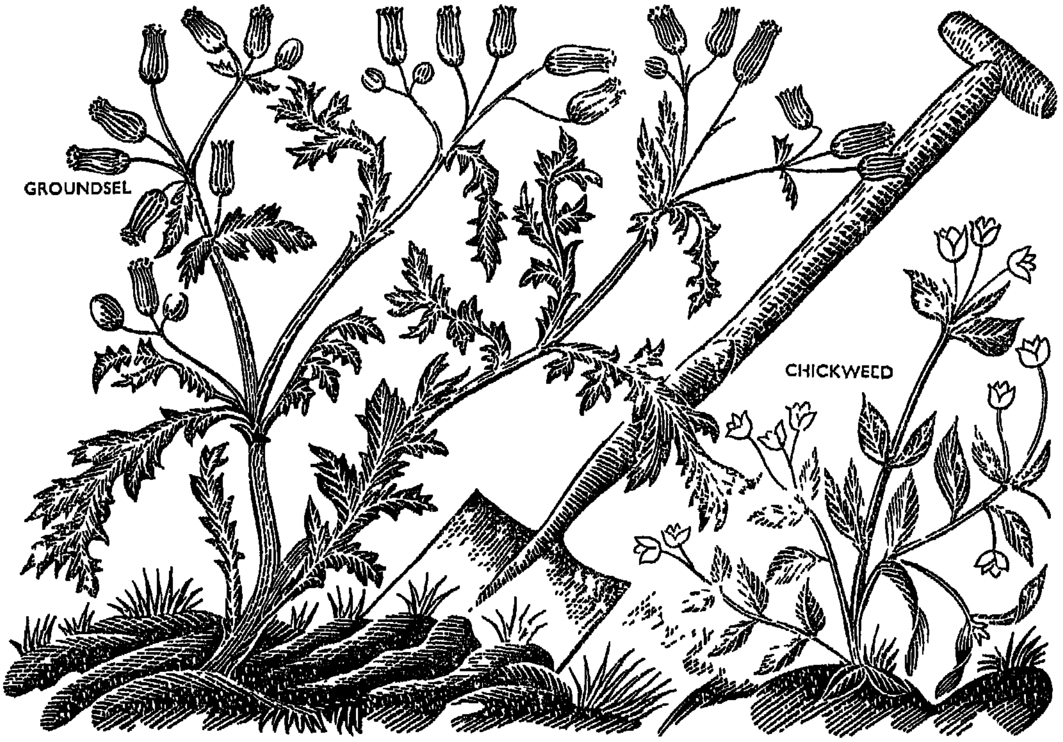
The plants that never flower are very common, but we do not always notice that they are flowerless. Perhaps the ones you are most likely to see are ferns. If you think about it, you will agree that you have never seen a fern in flower; not a real fern, at any rate, like bracken that grows on commons. But there are many other flowerless plants as well as ferns. There are mosses (though some of these have coloured tips to their stems that look like flowers), and lichens that grow on old walls and tree-trunks. Then there are horse-tails. These horse-tails often grow in sandy soil, and when you pull at their hollow stems they break apart easily at the joints.

Besides ferns, mosses, and horse-tails, no seaweed ever has a flower. Seaweeds belong to a group of plants called algæ, and no alga ever flowers. Other common algæ that you have probably seen form the green powder that collects on tree-trunks and wooden palings in damp weather.

So you can see that there is a great deal of plant life that is flowerless; and plants with flowers, though very common, are by no means the only ones that you find growing.

Now, as you will see, having flowers is a great advantage to a plant, and if you think about some of the flowering plants you know you will see that they make a great success of life. Take, for instance, the small weeds of our gardens. Shepherd's purse, chickweed, and groundsel are so successful that almost every dodge the gardener tries out to get rid of them fails.

Not only do flowering plants make a great success of life, they can be very small or very large, very long-lived or very short-lived; and they can make their living in many different ways and places. For instance, there are two very common plants that grow in the countryside. Very few people notice



Groundsel and chickweed can grow, flower, shed seeds, and die in as short a time as six weeks. Though they have coloured flowers, they pollinate themselves without the aid of insects. Groundsel is a particularly hardy plant which may sometimes be found in sheltered places in field or garden even as early as January.

them in flower, and both of them come into bloom at roughly the same time of the year—some time during April or May. They both look rather yellowish when the flowers come out; one of them is the smallest English flowering plant, and the other is probably the largest. The small plant is the lesser floating duckweed and the large one is an oak tree.

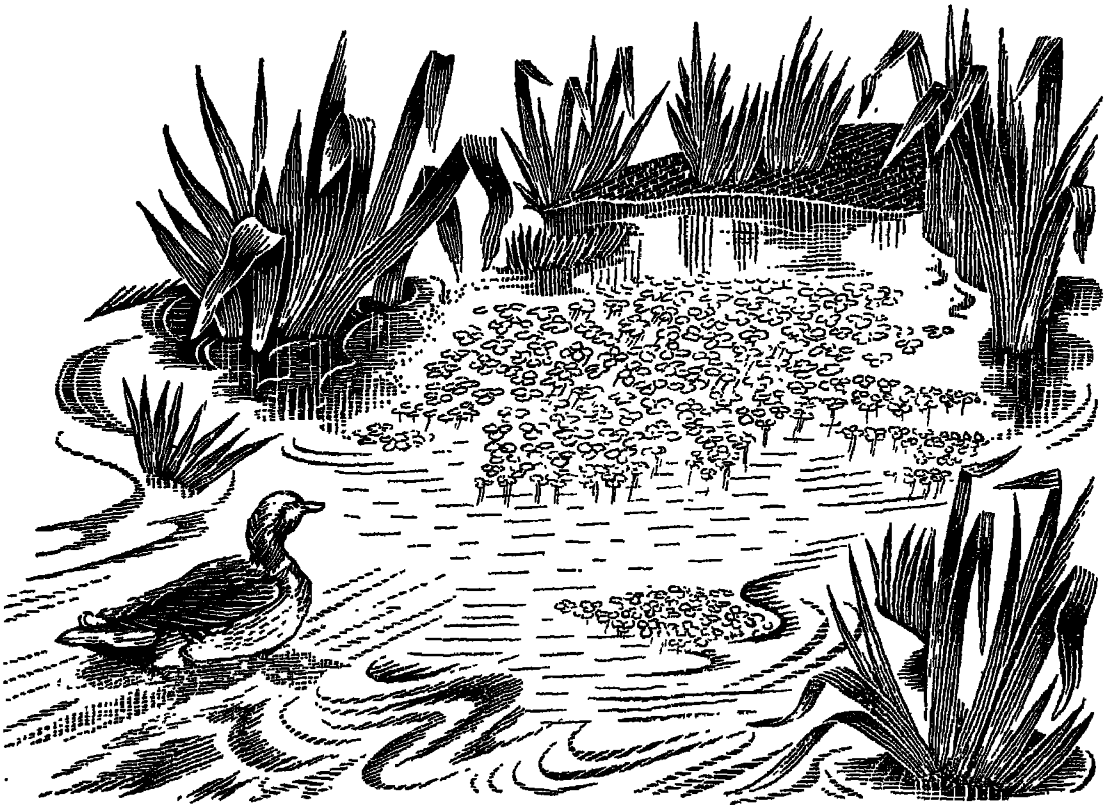
Not only is there a wide range of size among our flowering plants, but different plants take different lengths of time to grow up. You have probably noticed how those weeds, shepherd's purse and the rest, grow quickly in the garden. They seem to grow and flower almost overnight, particularly during the warm weather. Scientists have noticed that the time taken for chickweed and groundsel plants to grow, flower, shed their seeds and die, may be as short as six weeks. On the other hand, it takes most trees many years before they do the same.

Horse-chestnut trees do not flower until they are thirty years old, while few oaks are in flower before they are sixty, and then they flower every year until they die, sometimes at a ripe old age.

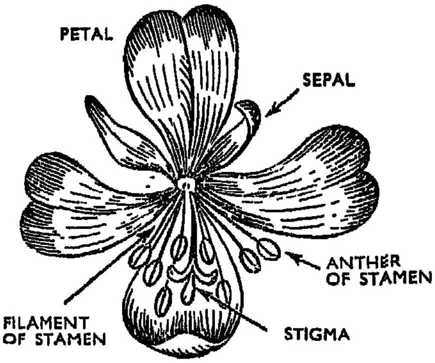
So, although flowering plants can be large or small, long- or short-lived, and although there are many different kinds of them, they all have one thing in common—they all have flowers. Let us see, then, exactly what a flower is, and what it does that makes it so useful.

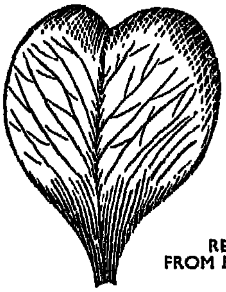
One of the easiest flowers to examine is the flower of the willow-herb. There are several kinds of willow-herb, but one of the commonest is the one we call rose-bay willow-herb. Some people call it fire-weed—possibly because of its colour, a deep reddish purple, or because it often grows in great masses on hillsides and other open places where trees have been burnt down. Rose-bay willow-herb starts flowering in July as a rule, and goes on right until the autumn frosts.

Take one of the flowers from the spike of blossom and you will see that it has four small greenish leaves at the top of the flower-stalk. Each of these is called a sepal, and the four sepals are called a calyx—a calyx of sepals. Within this calyx of sepals you will find the petals. These petals are brightly coloured, and there are four of them. If you have sharp eyes you will notice that the petals are not all quite the same size.

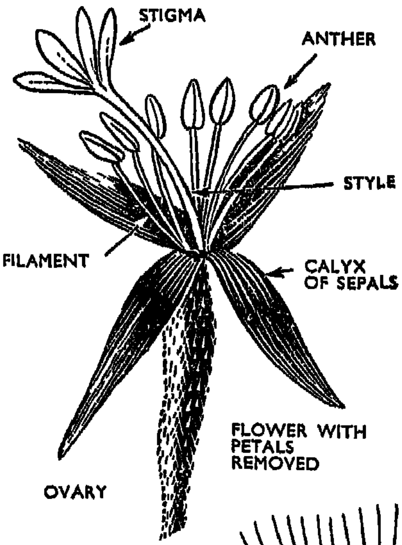


Duckweed is a plant of extremely simple structure which floats with its root growing downward into the water. It has tiny yellow flowers and is one of the smallest of the flowering plants. Sometimes there is so much of it that the surface of a pond may be completely covered.

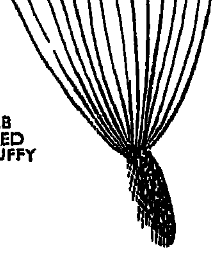




SINGLE PETAL REMOVED FROM FLOWER



FLOWER WITH PETALS REMOVED



WILLOW HERB SEED ENLARGED SHOWING FLUFFY PARACHUTE

Now gently pull the petals away from the sepals, and you will find that you have left behind a lot of little things on stalks. Eight of these stalked things are all alike, and we call them the stamens. Each stamen has two parts: a stalk—and this is often called its filament—and, at the top of the filament, the two little sausage-shaped anthers. The anthers contain the pollen, of which you will hear more later.

In the middle of the flower, within the circle of the eight stamens, you will see the most important part of the flower. It is called the pistil, and has three parts. Its top is in the shape of a cross, and is called the stigma. The stalk that holds the four branches of the stigma is called the style, and you can see it if you push the filaments of the stamens apart. The style leads down to the swollen base of the pistil, which is called the ovary.

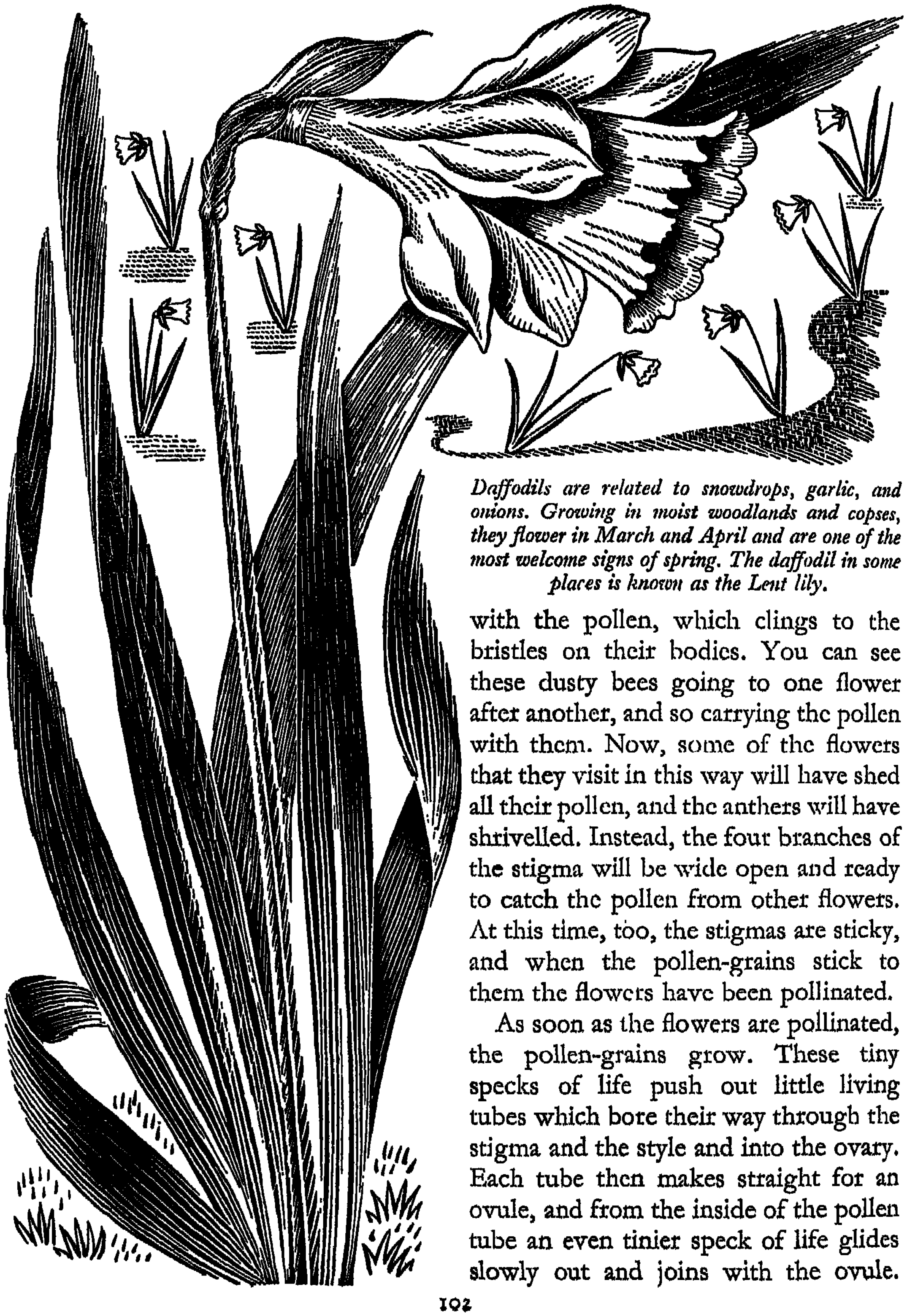
Now let us find out a little more about the pollen that is in the anthers. In most flowers it is a yellow powder, and if you look at it under the microscope you will see that each pollen-grain has a definite shape.

The pollen-grains of some flowers are egg-shaped, some are in three parts, some have spikes on them, and some, like those of flowers on marrow plants, have whiskers. These pollen-grains are alive, and help the flowers to form seeds so that more plants can grow. Pollen-grains cannot do this on their own, however; they have to join with some other little living grains that are inside the ovary of the pistil. These living grains in the

The rose-bay willow-herb is known also as fire-weed. Its tall, showy flowerheads are deep rose-purple in colour and are a common sight in early summer on waste ground, especially where trees have been felled

ovary are called ovules, and they are easier to see in a large flower than in a small one. Split open a daffodil flower from the stalk upward and you will see its ovules looking like tiny white pearls.

Let us get back to our willow-herb flower. In the summer when it opens you will see honey-bees flying to it and trying to crawl into it. They are searching inside it for the weak, sugary liquid called nectar that they will take back to their hive and make into honey. As they wriggle and stretch their tongues down into the flower they get smothered



Daffodils are related to snowdrops, garlic, and onions. Growing in moist woodlands and copses, they flower in March and April and are one of the most welcome signs of spring. The daffodil in some places is known as the Lent lily.

with the pollen, which clings to the bristles on their bodies. You can see these dusty bees going to one flower after another, and so carrying the pollen with them. Now, some of the flowers that they visit in this way will have shed all their pollen, and the anthers will have shrivelled. Instead, the four branches of the stigma will be wide open and ready to catch the pollen from other flowers. At this time, too, the stigmas are sticky, and when the pollen-grains stick to them the flowers have been pollinated.

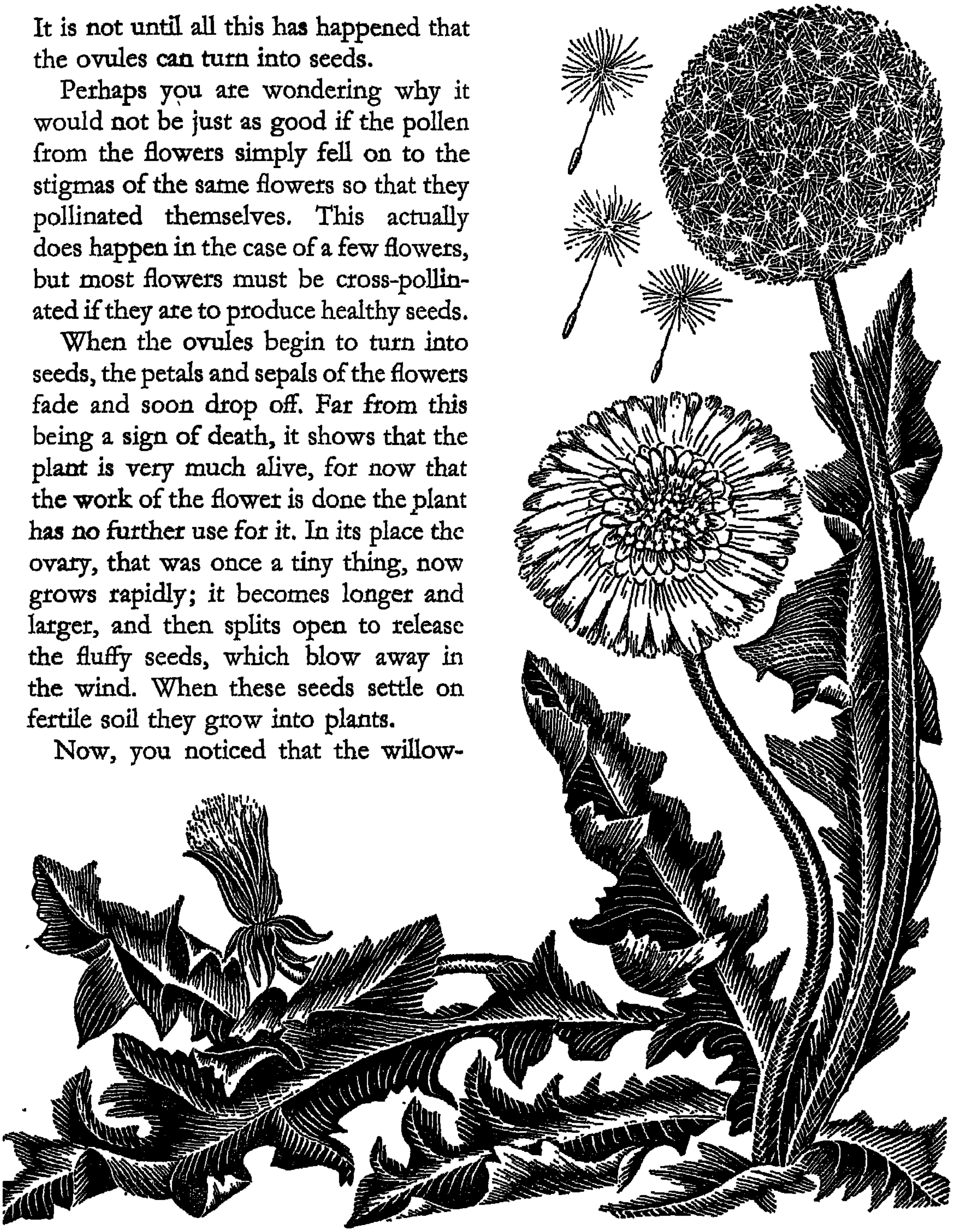
As soon as the flowers are pollinated, the pollen-grains grow. These tiny specks of life push out little living tubes which bore their way through the stigma and the style and into the ovary. Each tube then makes straight for an ovule, and from the inside of the pollen tube an even tinier speck of life glides slowly out and joins with the ovule.

It is not until all this has happened that the ovules can turn into seeds.

Perhaps you are wondering why it would not be just as good if the pollen from the flowers simply fell on to the stigmas of the same flowers so that they pollinated themselves. This actually does happen in the case of a few flowers, but most flowers must be cross-pollinated if they are to produce healthy seeds.

When the ovules begin to turn into seeds, the petals and sepals of the flowers fade and soon drop off. Far from this being a sign of death, it shows that the plant is very much alive, for now that the work of the flower is done the plant has no further use for it. In its place the ovary, that was once a tiny thing, now grows rapidly; it becomes longer and larger, and then splits open to release the fluffy seeds, which blow away in the wind. When these seeds settle on fertile soil they grow into plants.

Now, you noticed that the willow-



The French words for a lion's tooth are dent de lion *and the dandelion is so called because its leaves are said to look like lions' teeth. Its bright yellow flowers are followed by fluffy "clocks" each consisting of hundreds of dry nut-like fruits which are scattered by the wind.*

herb flowers contain nectar. This nectar acts as a bait and attracts the bees so that they help in cross-pollination. You also notice that the willow-herb has brightly coloured flowers. This is a great help to the bees when they are looking for nectar, since the colours show up at a distance. So you can be pretty certain that if a flower is brightly coloured and contains nectar it will be pollinated by some kind of insect, probably by honey-bees.

Honey-bees pollinate many flowers: the blackthorn and hawthorn of the hedges; the dandelions and clover in the meadows; and the blossoms of lime and horse-chestnut trees, to mention only a few. Blackthorn is out early in the spring, and the fruit that follows the white flowers when they fade and drop is called a sloe. It looks like a small purple plum and tastes very sour.

White clover is known also as Dutch clover. It is especially rich in nectar, and is used as a fodder crop for feeding to cattle.

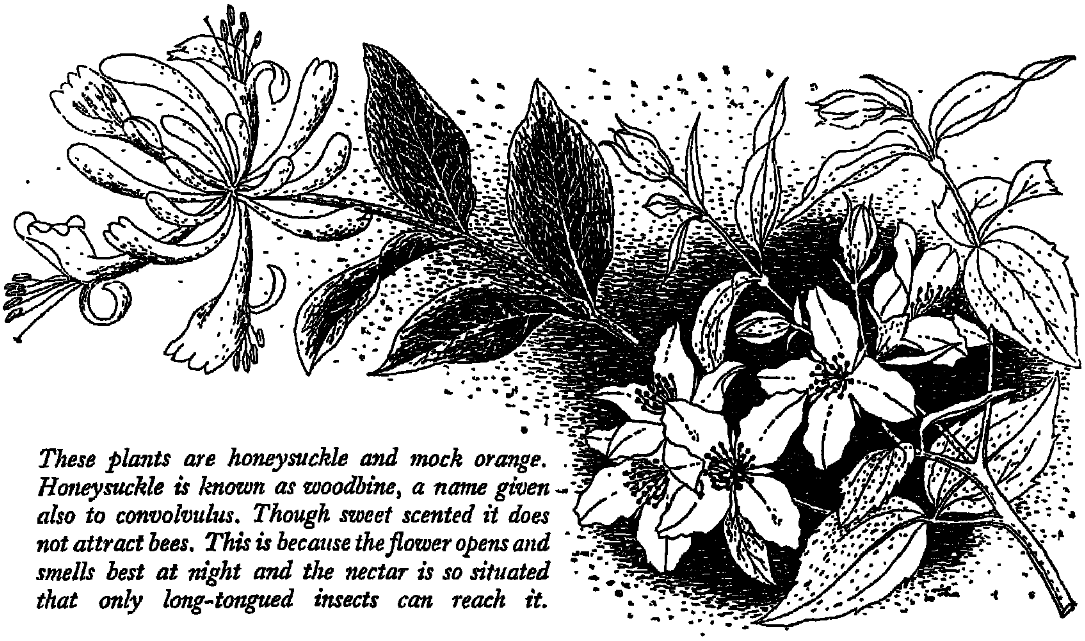
Hawthorn, too, has white flowers, and when they are out people call it may. It is true that it often flowers in the month of May, but equally often it is June before the hawthorn makes the hedgerows white with blossom. You will know the round, red berries of the may; they are called haws, and the leaves are said to taste of bread and cheese.

Most people have played with dandelion "clocks." These delicate, round, downy heads are made of bunches of dry dandelion fruits, each with its little hairy parachute. There are a lot of these little parachutes—each plant may produce as many as ten thousand or more of them. No wonder dandelions are such successful weeds!

Wild white clover is usually in bloom about the middle of June, and as each little blossom in the head of the flowers is pollinated it turns down and becomes brown. So you can tell by looking at the clover heads which ones have been pollinated.

Everybody knows horse-chestnut trees; their newly opened, sticky buds in the spring are followed by the great masses of flowers, so that each tree looks as though it had a lot of candles on it.

Lime trees come into bloom at about the same time as clover. The flowers hang downward, and when the bees



These plants are honeysuckle and mock orange. Honeysuckle is known as woodbine, a name given also to convolvulus. Though sweet scented it does not attract bees. This is because the flower opens and smells best at night and the nectar is so situated that only long-tongued insects can reach it.

are busy on them you can hear the hum of their wings quite a long way off. But the loveliest thing about lime trees in bloom is the delicious scent of the blossoms. This is almost as much help to the bees in finding them as the bright yellow of the flowers. When the lime blossom is over, the fruits that form are joined on to curious, long, slender leaves. These leaves act as a sail, and help them to be carried by the wind so that they do not all settle in one place.

Talking of scented flowers, you have probably noticed the strong smell of honeysuckle flowers. Although they are scented and have nectar, you never find honey-bees working on them. This is because the nectar is at the bottom of a tube, made of the petals, sticking out behind the flower. You can taste the nectar in this petal-spur if you pull it off and lick it. But bees cannot do this, and also cannot get their short tongues down to it. Instead, insects that have longer tongues, such as humble-bees and moths, pollinate this flower. In the same way, flowers like feverfew and meadowsweet often have peacock, red admiral and small tortoiseshell butterflies sipping from their blossoms.

Instead of having a pleasant scent to attract insects, the wild arum has an unpleasant one. In the early spring—about the time the hazel catkins appear—you will see green, glossy leaves poking up through the soil of the hedge-bottom. These leaves are shaped rather like arrowheads, and you will notice that some of them are rolled up round something long and slender. In the warm weather these leaves unroll, and you can see that each one has a purple spike inside. You cannot see the lower end of this spike until you pull off the leaf, then you will see first a ring of bristles which slope downward, then some tiny flowers with stamens only and, at the bottom of the spike, flowers with

In June the hedges are splashed with pink and white as the blossoms of the wild rose unfold. It is by careful cross-breeding of the wild flowers that all the beautiful types of rose to be seen in gardens through the summer have been developed.

pistils only. These last look like round ovaries and little more.

When the leaf unrolls, the purple spike gives off a faint and unpleasant smell. This attracts flies and other small insects, which crawl down the spike to find out what it is all about. They push their way past the bristles, over the stamens—which are not yet open—and down to the bottom. Here they walk about, and pollen that they have brought from another spike falls on to the ovaries, pollinating them.

The insect, after taking a drink of nectar, crawls up again in order to get out; and then it has a bit of a shock. Those bristles that were so easy to push past on the way down are all sticking out from the spike and pointing at it. Walking past them is now a very different matter. It is, in fact, quite impossible. So the unfortunate insect wanders about, waiting for something to turn up. It does not have to wait long, for before a day is past the anthers of the stamen-flowers open, and as the insect scrambles about among them it becomes smothered with pollen. Almost at the same time the bristles shrivel and crumple, and the very dusty insect escapes.

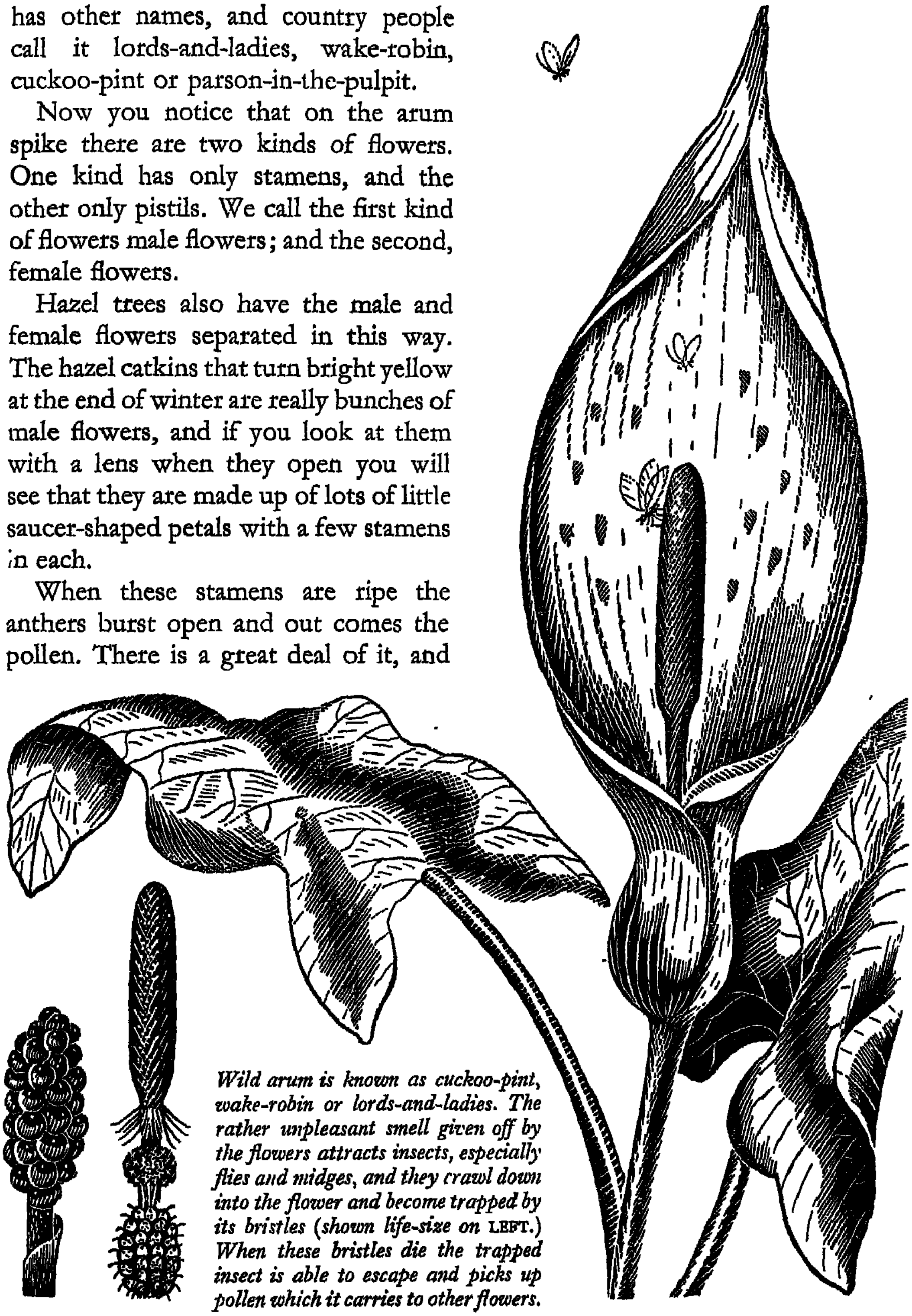
You would think that this would teach it a lesson, but insects are not very intelligent, and you will soon find it inside another arum, where it pollinates the ovaries as before.

If you look about in the same hedge during August you will find that the leaf, spike and all the rest of the arum have died down, leaving only some bright-red berries on a stalk. Many people who see these berries do not realize that they have come from the wild arum flowers. By the way, the plant has other names, and country people call it lords-and-ladies, wake-robin, cuckoo-pint or parson-in-the-pulpit.

Now you notice that on the arum spike there are two kinds of flowers. One kind has only stamens, and the other only pistils. We call the first kind of flowers male flowers; and the second, female flowers.

Hazel trees also have the male and female flowers separated in this way. The hazel catkins that turn bright yellow at the end of winter are really bunches of male flowers, and if you look at them with a lens when they open you will see that they are made up of lots of little saucer-shaped petals with a few stamens in each.

When these stamens are ripe the anthers burst open and out comes the pollen. There is a great deal of it, and



Wild arum is known as cuckoo-pint, wake-robin or lords-and-ladies. The rather unpleasant smell given off by the flowers attracts insects, especially flies and midges, and they crawl down into the flower and become trapped by its bristles (shown life-size on LEFT.*) When these bristles die the trapped insect is able to escape and picks up pollen which it carries to other flowers.*

as the catkins sway about in the gusty weather the pollen floats out. Some of it lands on the female hazel flowers, which look like little buds, and you can see the deep-red stigmas poking out at the ends. Later on these buds turn into hazel-nuts.

HOW PLANTS ARE POLLINATED

So far, then, you see how different flowers have different ways of being pollinated. Some offer a bait to insects so that they carry the pollen from flower to flower; others, like the hazel, let the wind carry the pollen away, in the hope, as it were, that some will land on a stigma. Willow is like hazel, and blooms soon after it, with golden male flowers that people call "palm." It is often used to decorate churches on Palm Sunday. The female willow flowers are silvery-grey, furry things when they first open, and people call them pussy willow.

Most flowers that are wind-pollinated do not need very noticeable flowers, and this explains why so few people have noticed that ash and elm trees have flowers. Grasses, too, have green flowers that produce a great deal of pollen.

Now, once your flowers have been pollinated and have produced the seeds, it is important to scatter them widely so that each seed has plenty of room to grow. Willow-herb, you remember, has fluffy seeds, and dandelions have "parachutes." We know that they must go great distances, because these plants have sprung up in the hearts of big cities where old buildings have been pulled down. As you walk along the lanes and over the fields you will see many other plants that do the same sort of thing.

If you gather some of the grey, fluffy masses of old man's beard that you find on the hedges in winter you will notice that it is made up of lots of little seeds, each with its plume-like "parachute." Colt's-foot, which has very early, dandelion-like flowers, has similar parachutes, and so has ragwort, that blooms in the late summer. But there is a mystery about thistles. They produce lots of thistle-down, and the thistle-down is full of seeds; and for many years people thought that this was how thistles were spread. Then someone tried to make the thistle seeds grow in a flower-pot, and of all the millions of seeds that they planted very few came up. So it seems that these seeds do not spread the thistles nearly as much as people thought, and though we know that the plants can creep a long way underground, no one knows why they should produce all those useless seeds.

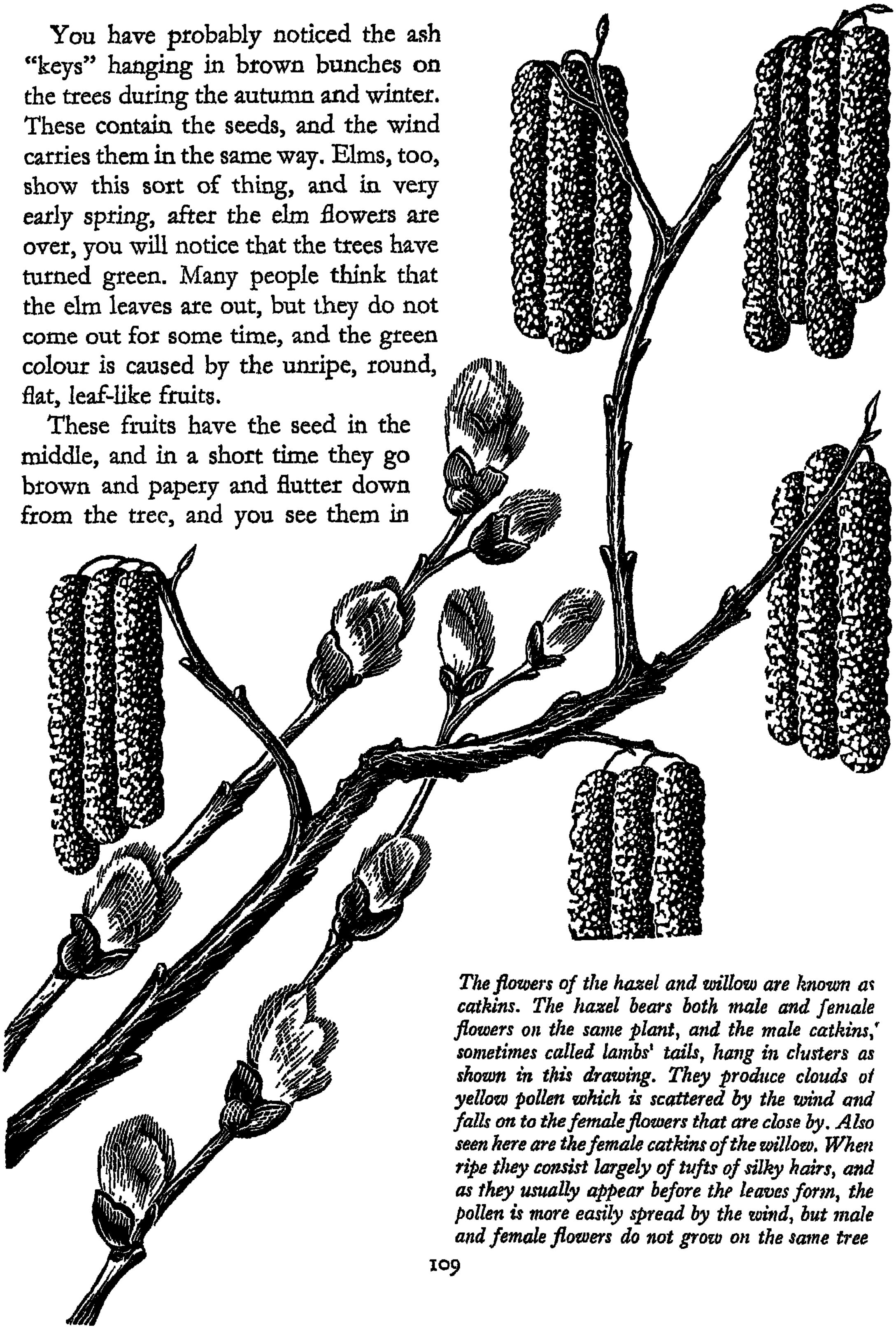
There is, however, no mystery about ragwort. Its little parachutes grow so well, in fact, that it is one of the farmer's worst weeds.

PLANTS WITH "PROPELLERS"

Besides the plants with "parachutes," the wind helps plants whose fruits and seeds have sails to get about. You know about lime trees, and you have probably seen the "propellers" from the sycamore trees. Sycamores are not really English trees, but they are closely related to the maple of the hedges of Britain, which has similar propellers.

You have probably noticed the ash "keys" hanging in brown bunches on the trees during the autumn and winter. These contain the seeds, and the wind carries them in the same way. Elms, too, show this sort of thing, and in very early spring, after the elm flowers are over, you will notice that the trees have turned green. Many people think that the elm leaves are out, but they do not come out for some time, and the green colour is caused by the unripe, round, flat, leaf-like fruits.

These fruits have the seed in the middle, and in a short time they go brown and papery and flutter down from the tree, and you see them in



The flowers of the hazel and willow are known as catkins. The hazel bears both male and female flowers on the same plant, and the male catkins, sometimes called lambs' tails, hang in clusters as shown in this drawing. They produce clouds of yellow pollen which is scattered by the wind and falls on to the female flowers that are close by. Also seen here are the female catkins of the willow. When ripe they consist largely of tufts of silky hairs, and as they usually appear before the leaves form, the pollen is more easily spread by the wind, but male and female flowers do not grow on the same tree dusty heaps where the wind has blown them by the roadsides and paths. Here we have another thistle mystery, for very few of these elm-seeds can grow, even if they fall on fertile soil.

You remember that hawthorn and wild arum have red berries in the autumn. These berries are not only red, but are juicy as well. Animals like them, and in winter you will often see hungry birds pecking at them, too. Although some birds and animals eat these berries, they cannot digest the seeds, and as they make their way about the countryside the seeds pass through their food-canals and are cast out with their droppings. So the seeds are scattered far and wide.

Many other plants have brightly coloured, juicy berries of this kind. Blackberries and rose-hips are common examples; less well known are the brilliant red berries of white bryony, woody nightshade and honeysuckle, and though they are quite harmless to birds and animals, these berries, like those of wild arum, are poisonous to human beings.

As you go about the lanes and fields in autumn you will see many more plants that have bright juicy fruits with pips in them. There are holly berries, both red and yellow; ivy, elder, dogwood, and wayfaring tree—these have dark blue or black fruits; and also snowberry, whose white fruits follow the little pink snowberry flowers. Sometimes you will see the vivid scarlet of the waxy barberry fruits, and the deep pink spindle-berries that crack open and show their bright orange seeds. Both these plants are becoming scarce because they harbour crop diseases and farmers do not like them on their land.

Some wild flowers have their seeds scattered by animals in another way. The seeds have hooks, so that as an animal brushes past them they stick to

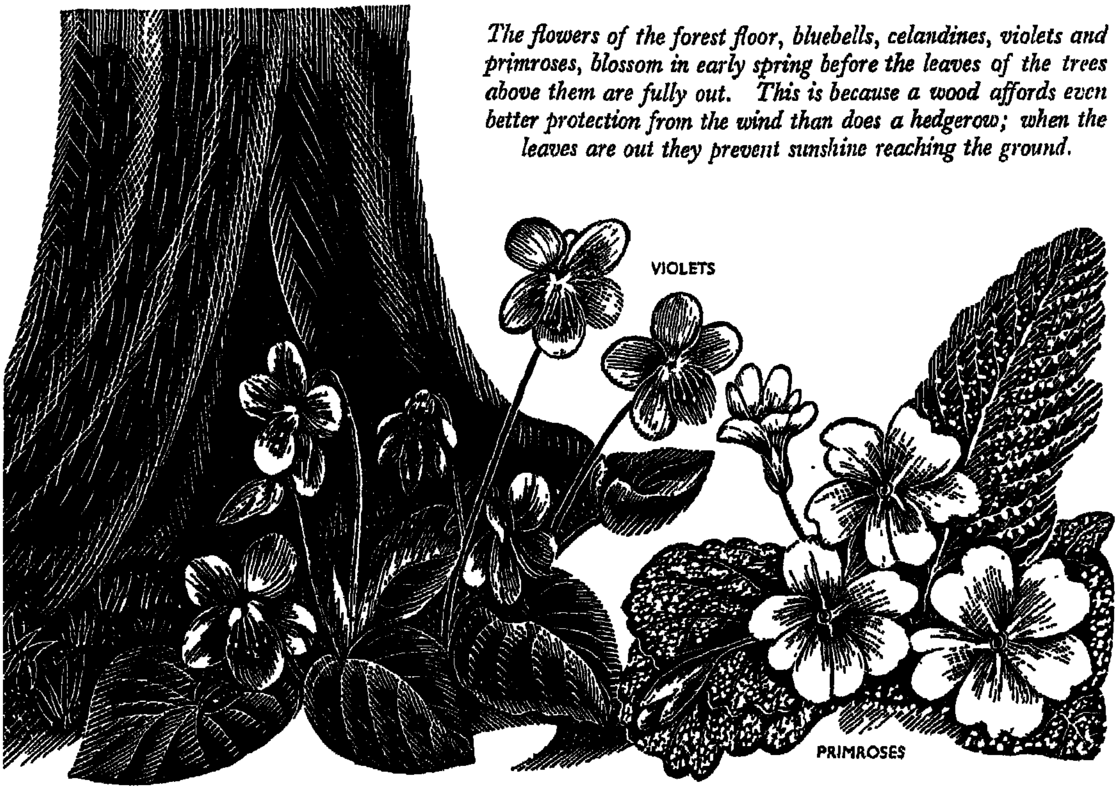
its furry coat. Then later on, as the animal jogs along, the seeds drop off one by one far away from the plant that bore them. Most people know goosegrass, that sticks its little round spiky seeds to your clothing as you walk by the hedgerows. Some people call it cleavers or sweethearts.

Many people know burdock, too. Its stems have quite large, round, spiky tops, called burrs. The burrs remind you of thistle-heads, and they have hooks and contain the seeds. Burdock grows in the hedges and at the edges of woods, and its leaves are flat and smooth, not spiny like those of the thistle. But not many people seem to know avens, with its hooked seeds. This is strange, because avens is a very common hedgerow plant. It has small, yellow, buttercup-like flowers in the summer, and when they fade the hooked seeds are left behind.

Agrimony, too, is fond of sheltered places and has small yellow flowers. Each of its little dry fruits looks like a tiny vase with a ring of hooks round its shoulder. Wild carrot has hooked seeds, too. It belongs to the same family as hedge parsley, and the seeds stick to you like burdock and goosegrass.

Now, some wild animals, like voles, are very fond of hazel-nuts, beech-nuts and acorns, and sometimes while they are eating them in the shelter of a hedge they catch sight of an enemy—a stoat, a weasel or an owl. There is only one thing to do, and they do it as quickly

The flowers of the forest floor, bluebells, celandines, violets and primroses, blossom in early spring before the leaves of the trees above them are fully out. This is because a wood affords even better protection from the wind than does a hedgerow; when the leaves are out they prevent sunshine reaching the ground.



as possible. Dropping the nut they are just about to enjoy, they scuttle for home and safety. The end of this story is often rather sad for the vole, but happy for the stoat, weasel or owl.

PLANTS OF WOOD AND HEDGEROW

Whether the vole escapes or not, and whether its enemy's babies are fed or not, makes no difference to what happens to the nut or acorn. There it lies where it has rolled, and during the mild, damp days of autumn it bursts out of its woody case and pushes its roots into the soil. The following spring it sends up a shoot, and soon grows into a sapling. Of course, many of the saplings are eaten by voles and rabbits during the winter, but some of them will grow up, and that is why you often find hazel, oak, and beech trees in the hedgerows.

You will notice that nearly all the plants we have so far thought about live in the hedgerows and round the edges of fields, and many people think that they get there either because their seeds are blown there by the wind or because animals and birds carry them there. Though this is partly true, it is also true that the same kinds of seed are dropped in open fields, but the plants do not thrive there because many of them are cut down when the farmer mows the field, or his cattle eat them as they graze. So now you can see why certain plants are known as hedgerow plants. There are many others besides the ones mentioned, and they all seem to do well in the shelter that the hedge provides.

In many ways a wood is like a hedge, although it gives more shelter than a hedge, and, where the oak and ash trees are fairly close together, a good deal more shade. As you walk from the bright, sunny fields into the cool shade of a wood you will notice how different are the flowers. You will see the hazy blue masses of bluebells.

Then there are primroses, and lesser celandines, too, brighten things up with their yellow flowers; and you will also find your old friend wild arum, and with it dog's-mercury, with its quaint green flowers. At different times of the year you will see wood-anemones, wood-violets and wood-sage in bloom. Wood-sage is interesting, for wherever you find it growing you know that the soil is free from lime, for wood-sage cannot live in a limey soil.

FLOWERS ON PLOUGHED LAND

These are just a few of the plants that grow in the woods. There are others less common, and some that are very rare and strange. Just as you find certain plants in woods and hedges, so you will notice that ploughed fields have their own special wild flowers. Ploughing buries the turf in a field, and this kills it so that the farmer is able to sow the seeds of another crop. Before long the fields are green with the leaves of his crop, but among his plants there are others of which he has no need. If he does not kill these weeds he may find at harvest-time that he has more weed-seeds than corn, and you sometimes see fields where the weeds are getting the better of the crop.

Among the green standing corn you

BLUEBELLS IN SPRINGTIME

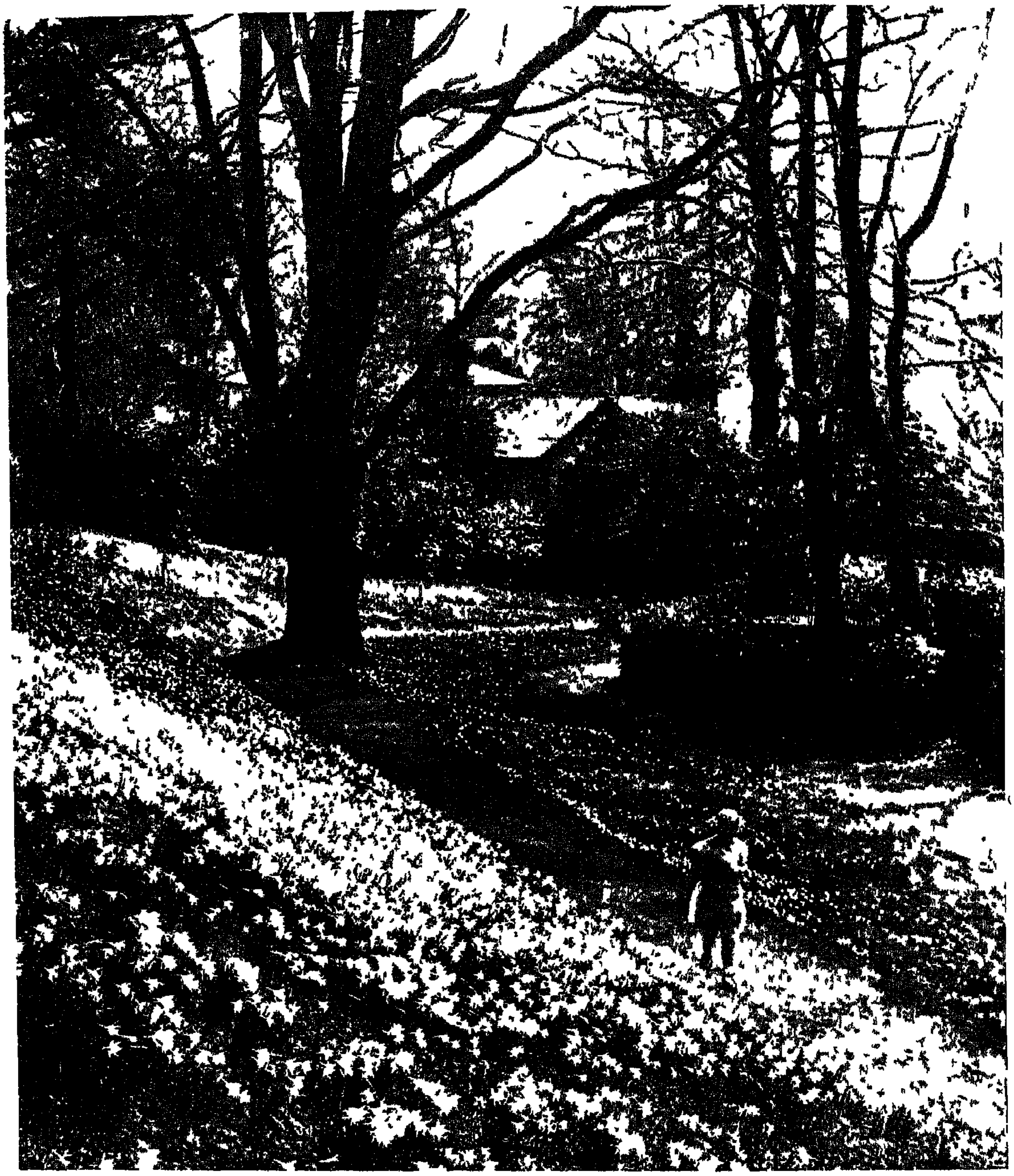
Carpeting the floor of many an oak wood or coppice, bluebells open their blossoms in the spring sunshine. The lance-like leaves break through the soil before the leafy canopy of the trees has become dense and they are followed closely by the flowers. Each flower is formed during the previous autumn, but lies dormant through the winter. Bluebells are grown from bulbs. The leaves are the plant's factory, where food is made from the gases of the air and the minerals from the soil. In the dense shade which the trees throw in summer the bluebell foliage withers, its food draining back into the bulb, where it is stored through the winter. If the bulbs are pulled up the plants die.

WOODLAND FLOWERS IN SPRING

In spring, while the trees are still leafless, the woods of Britain are gay with the blossoms of many wild flowers. Even while snow covers the ground, hardy snowdrops (left) *push slowly upward through the soil and at the first spell of sunny weather open their buds to display their drooping white flowers tipped with green. Though they are now such a familiar and welcome sight, it is believed that snowdrops are not native to Britain but were imported. As the days lengthen and the warmth from the sun increases, other wild flowers come into bloom. Of these, primroses* (below) *are well known for the fresh green of their leaves and their bright yellow flowers. They are so closely related to cowslips and oxlips that they will crossbreed with them, forming hybrids which may be found growing wild. Among primroses, two kinds of blossom may be found; one in which the centre of the flower shows the stamens, the other in which the stigma shows*

HEDGEROWS IN SUMMER

Along the sides of paths and lanes in the country countless wild flowers bloom freely, especially during the summer. Below *can be seen how strongly the wild flowers have grown on the bank beside the road where neither cattle graze nor the farmer ploughs. In the field the grass has been kept short and the wild flowers checked by grazing cattle. The white flowers in the foreground of the picture are those of cow-parsnip (not cow-parsley), which is also called hogweed. Fields often are surrounded by a hedge of hawthorn, forming a living fence of dense growth with sharp spikes. The hawthorn hedge shown on the* right *has been neglected. It is overgrown by wild roses, which can be seen in bloom. The wild rose has a weak stem and can thrive only when it has the support of a plant such as hawthorn. If not kept in check the rose will kill the hawthorn and then, because of its weak stems, animals will break through the hedge despite its spikes. The white flowers in the foreground are called ox-eye daisies and are more closely related to chrysanthemums than to the daisies of the lawn.*



DAFFODILS

Whether growing wild in meadows or woods or when carefully planted in a garden, the graceful golden daffodils are a lovely sight Though they produce flowers during March and April, their seeds are not often seen and the flowers usually are grown from bulbs In the autumn the leaves wither and the food from them passes downward into the bulb, which swells and forms new bulbs At first the new bulbs are small and produce only leaves, but as they grow larger the beautiful flowers come from them as well Daffodils are known sometimes as Lent lilies will see splashes of white campion, the brilliant yellow of charlock and the vivid scarlet of poppies. In the summer sunshine they look very lovely, but the owner of the field would rather do without them. There are dozens of different kinds of weed that appear in ploughed fields in this way—there are redshank and penny cress, herb robert and forget-me-not, speedwell and cornflower, and a host of others, all of which grow, flower, shed their seed and die, all in one season.

Plants that live for one year only, in this way, are called annuals, and because their life is short they do not need to store any food in their roots. If their tops are cut down or eaten before they have shed their seed they are usually too weak to recover. That is why you seldom find them in fields that are grazed on by sheep and cattle or mown.

SEEDS THAT LIE DORMANT

When the grass field is ploughed, however, the seeds of these annuals that have been buried too deeply to grow are brought near to the surface and therefore come up with the corn. The remarkable thing is that they come up even in fields that have never been ploughed within living memory, and we know from this that some of these annual weed-seeds can live in the soil for a hundred years and still grow.

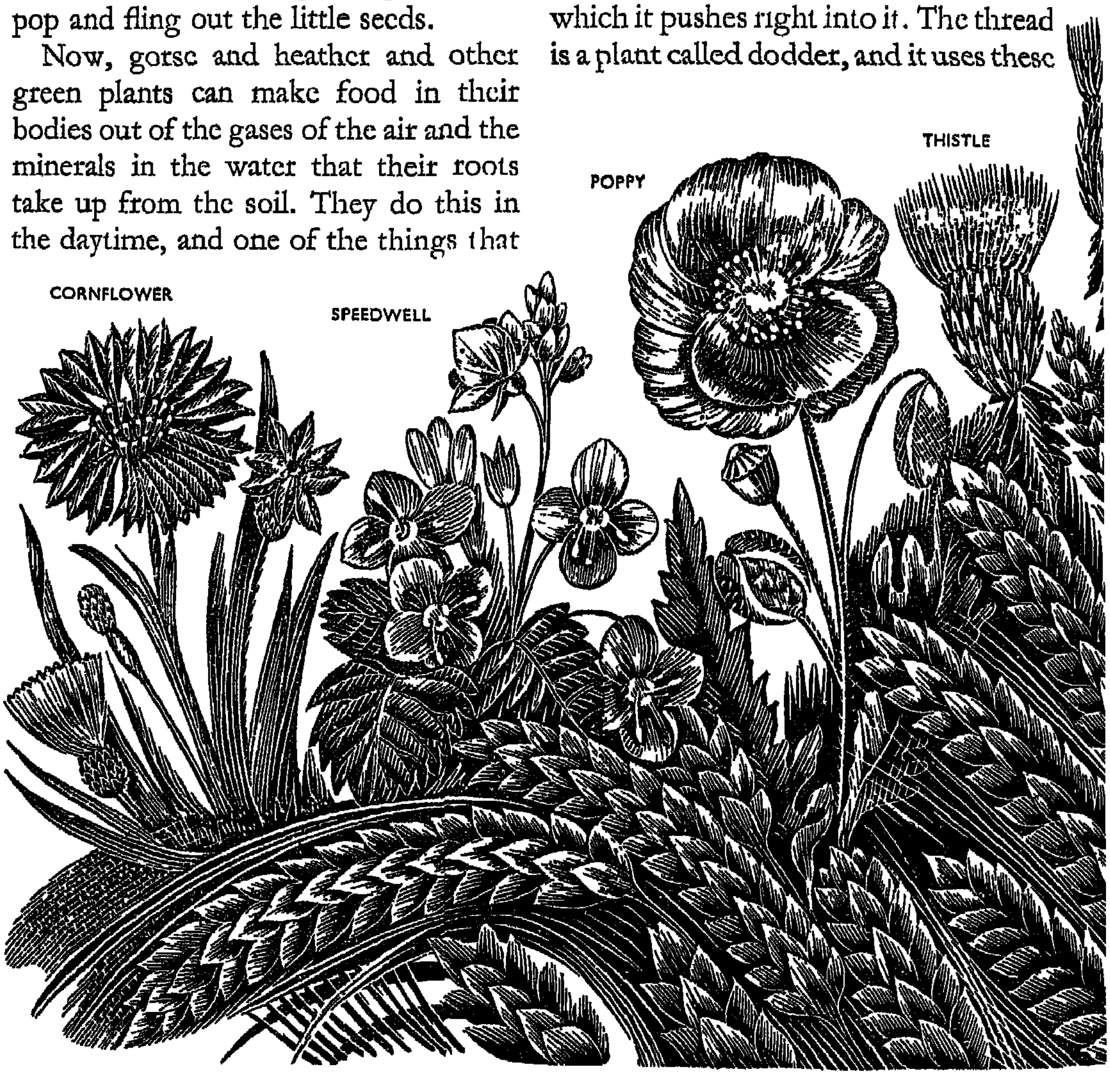
Though many wild flowers will grow almost anywhere, some, such as wood-sage, are so particular about the soil they like that their presence tells you something about the soil they grow in. In the same way, you can be pretty certain, if you see a good growth of wild pansy (or heartsease), that the soil is poor, hungry stuff; and for the same reason no farmer is very pleased if he sees much colt's-foot or restharrow in his ploughed fields. These two plants can live for many years because they store food in their roots, so we call them perennials. Other perennial weeds of ploughland are sheep sorrel and buttercup, bindweed and ground ivy, thistles and scabious, and many more besides. Some of them are very beautiful, and it is a pity they are so troublesome, for, though they hinder the farmer, our country walks would be dull indeed if he got rid of them all.

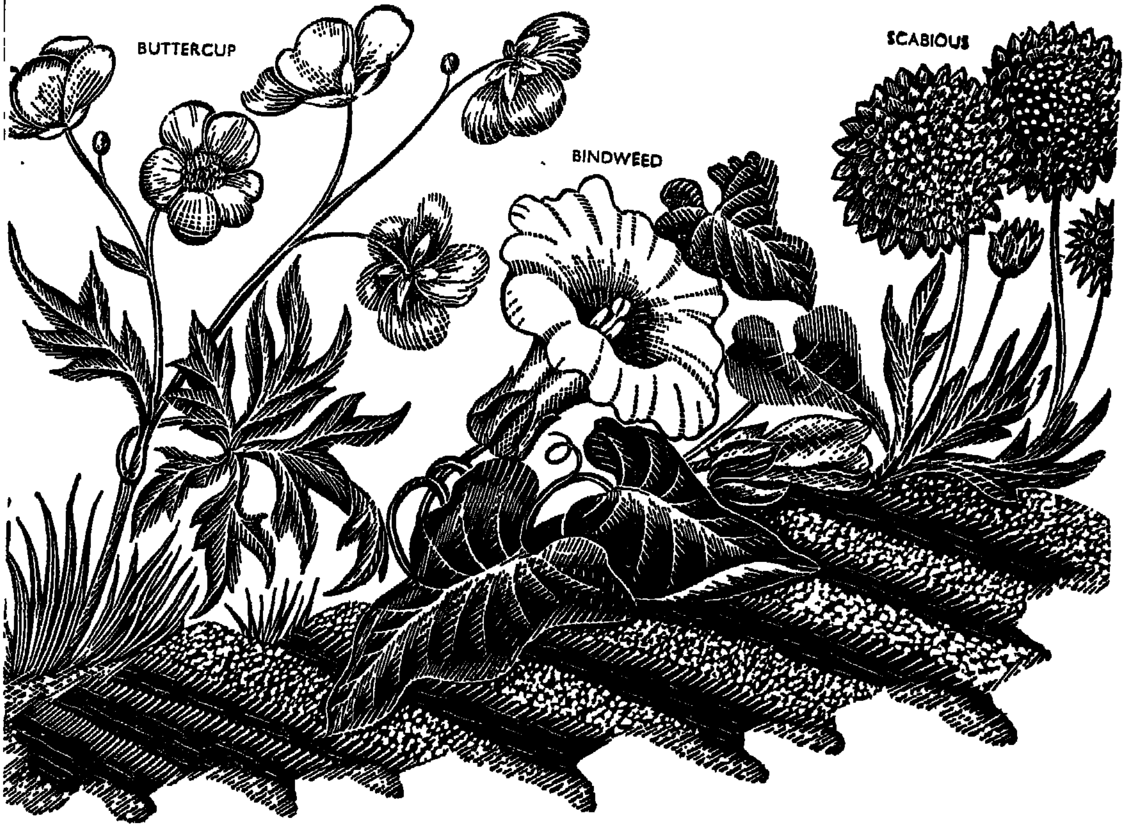
FLOWERS IN UNEXPECTED PLACES

Some of the finest wild flowers grow in the most unexpected places. That odd untidy corner of a field that seems to be of no interest may shelter a rare specimen whose very existence is possible only in neglected places. One of these plants is the deadly nightshade, which is much rarer than most people think. You sometimes find it in disused and roofless barns, and you will see how different it is from the woody nightshade of our hedges and the little black nightshade that sometimes grows as a weed. Deadly nightshade has large flowers in the summer, and in the autumn its big juicy berries are a very deep blue. As you look at this strange, handsome plant you hardly need reminding that it is very poisonous.

Heath and moorland have flowers growing on them that you seldom find in other places. Perhaps the commonest plant is heather, and with it bell heather, which is really not a true heather at all. You will be able to tell the difference between these two because true heather has coloured sepals and its flowers look double, while bell heather has bell-shaped single blossoms. Here, too, among many other heath flowers you will find gorse growing. Gorse has yellow flowers, and there is hardly a month when it is not in bloom. In the warm weather its dark pods open with a pop and fling out the little seeds.

Now, gorse and heather and other green plants can make food in their bodies out of the gases of the air and the minerals in the water that their roots take up from the soil. They do this in the daytime, and one of the things that helps them is the chlorophyll in their leaves and stems. Sometimes you will see a tangle of pinkish-red threads growing on the gorse. You find it on heather, too. Look at these threads very carefully and you will see that here and there they are wound tightly round the stems of the plant. However hard you try, you cannot get the threads unwound without breaking them. This is because the red thread clings tightly to the stem of the green plant by some little suckers which it pushes right into it. The thread is a plant called dodder, and it uses these



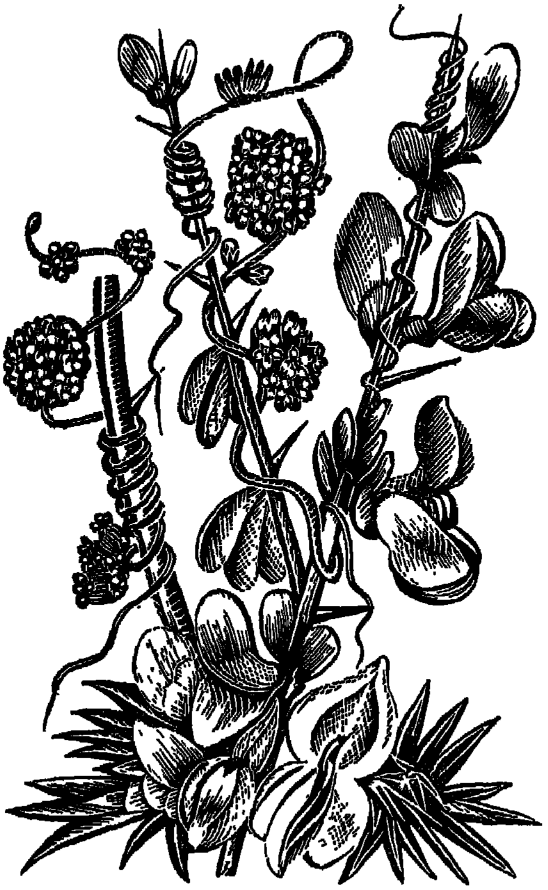


Cornflowers and poppies, speedwell and thistle, are to be seen growing among the corn. Buttercups, bindweed and scabious often grow in grass fields. Although all the flowers look pretty, the farmer would prefer to see his fields without these weeds because they use food which he would rather see used by his corn or the grass which provides valuable food for his cows.

suckers to rob the green plant of its food.

A plant that eats its way into other living plants is called a parasite, and the poor victim is called its host. Now you can see why dodder has these thin red stems. They need not be green, because it relies on its host to give it food, and they can afford to be weak because its host holds it up as well. In the summer the pink dodder flowers come out, and when they fade there are thousands of tiny dodder seeds. These seeds are scattered over the ground, take root and grow. The seedlings can live for a time on their own, but if they do not soon find a green plant to which they can cling and which they can rob, they die. Dodders that sway about and do manage to find a host, feed and grow on it and, having no more use for their roots, let them shrivel and die.

In wet and muddy parts of a heath you can find clumps of low-growing plants of which the small spoon-shaped spiky leaves glisten with little golden drops on the ends of the spikes. This is a stranger plant even than dodder, and



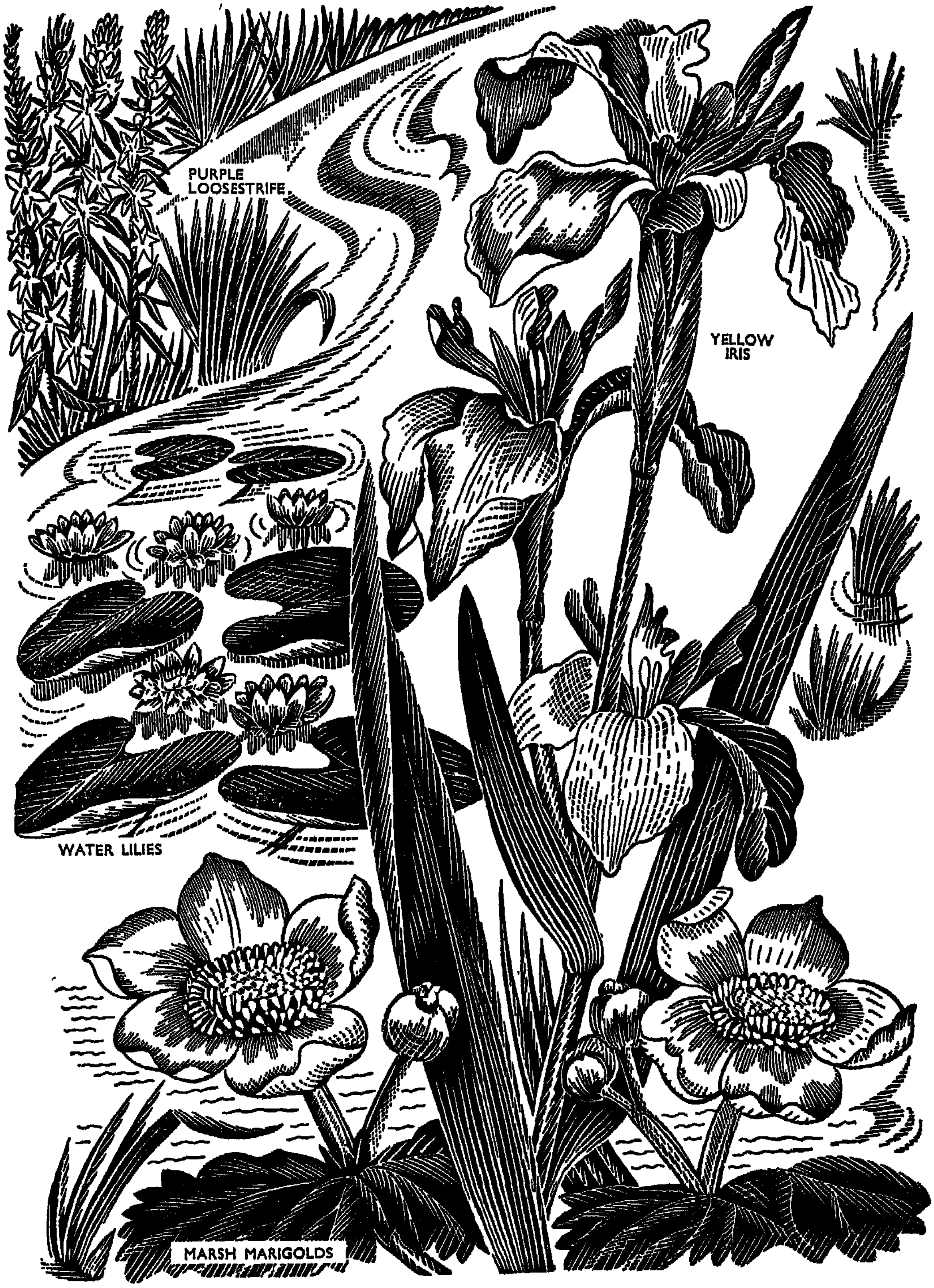
Dodder has no root of its own but twines its thread-like stems around the spiny gorse to rob it of its food. Dodder bears clusters of small flowers and sheds very many seeds.

because of its glistening drops it is called sundew. Sit quietly and watch it.

Sooner or later a fly or midge or some other small insect will come to find out what all these golden drops are about. It lands on a leaf, only to find that it is extremely sticky—so sticky, in fact, that there is no getting away from it, and it struggles and buzzes in an attempt to do so. This only makes matters worse, because all this struggling wakes the plant up, as it were, and slowly but surely it curves its sticky spikes inward toward the middle of the leaf. As the little golden drops run together, the insect, now in the middle of the leaf, is drowned in the sticky fluid. This fluid digests the insect's body and the goodness passes into the leaf; so that when the spikes straighten out again the few shrivelled remains of the insect blow away in the wind.

Like heaths and moors, ponds and rivers, too, have their own special plants. As you walk by the waterside you will not be surprised to find willows, rushes and reeds, for these are lovers of dampness. But with them in the muddy soil you will find marsh marigolds and spearmint (whose scented leaves you will easily recognize), flags and irises, water plantain and purple loosestrife, to mention only a few common plants. Floating on the water you will see duckweed, and often two kinds of water lilies—one with white flowers and one with yellow. While completely submerged in the water, the different kinds of pondweed poke their stems into the air only when they want to flower. In some rivers you will find the bladderwort. This plant floats under the water and has little hollow bladders on its stems. Water-fleas bump against these bladders, only to find that they have little trap-doors in them that open easily and let them in and then shut firmly behind them.

We could long continue wandering in this way in the fields and hedgerows, through woods, over the moors and by streams and rivers. Wherever we went the wild flowers would provide us with much that is interesting and beautiful.



FLOWERS OF THE RIVER

On the farm

Sometimes when you are out in the country you go along a lane and come to a gate—the gate of a farm. Do you ever wish you could go through the gate and see what the farm is like? Farmers are friendly folk and often do not mind people walking round, provided that they do not hinder them and are careful to keep the gates shut. So let us have a look round the farm.

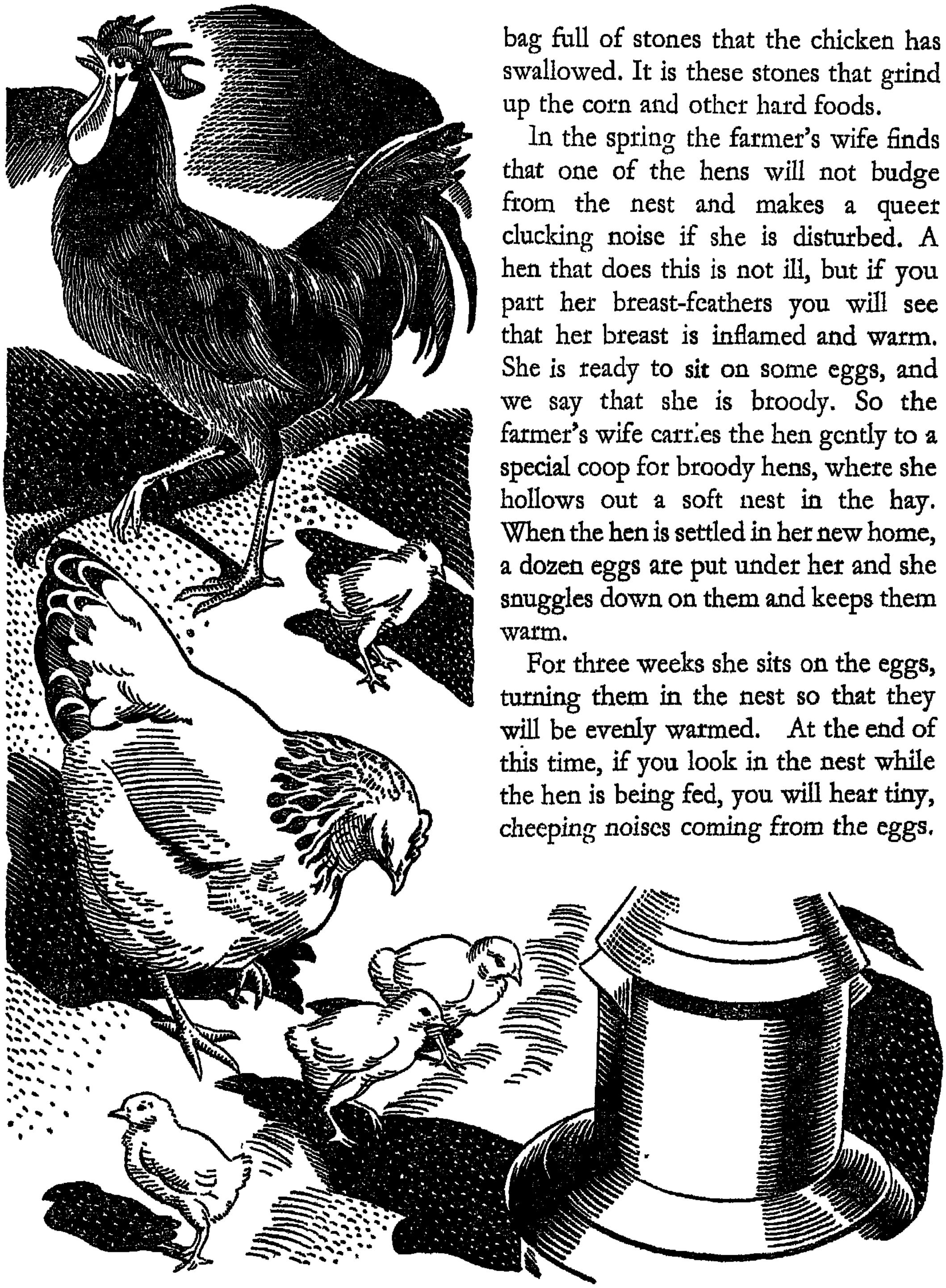
You will notice the farmhouse where the farmer lives, and nearby are the farmyard, the rickyard and the fields where he works. Not many people have their workshop so near to their home; but a farmer must be able, at any hour of the day or night, to see that all is well in his workshop. Even in his home he has part of his workshop; for round the house he has an orchard where he grows his apples, pears, and plums, and you can see his ducks paddling about there, too. Then he has a kitchen garden for growing vegetables, and a patch for soft fruits—raspberries, strawberries, currants, and gooseberries. Out in the paddock by the orchard he keeps a few chickens in order to get the eggs, and perhaps so that he can have a chicken on his table now and again, and some farmers also keep geese and turkeys. All these things need a good deal of attention, and that means hard work for the farmer and his wife.

It is usual for the farmer's wife to look after the fowls, and every morning and evening she goes out to feed them. In the morning she gives them a kind of mash. This mash contains the part of the wheat-grain that is not used in making white flour. It is called toppings and looks like a coarse greyish-brown flour. The farmer's wife mixes it with water to make the mash. The evening feed consists of corn, which she scatters on the grass. While the chickens are eating their corn she looks in the nest-boxes in the chicken-house for any eggs that have been laid. It is the hens or pullets (young hens) that lay the eggs. When the cocks are big enough they are usually prepared for the table and eaten.

Have you ever wondered how chickens, which have no teeth, can grind up hard food like corn and get the goodness out of it? They grind it up after they have eaten it. This is done in a special part of their stomach called the gizzard. It is liver-coloured, but tough and muscular, and inside it is a bag full of stones that the chicken has swallowed. It is these stones that grind up the corn and other hard foods.

In the spring the farmer's wife finds that one of the hens will not budge from the nest and makes a queer clucking noise if she is disturbed. A hen that does this is not ill, but if you part her breast-feathers you will see that her breast is inflamed and warm. She is ready to sit on some eggs, and we say that she is broody. So the farmer's wife carries the hen gently to a special coop for broody hens, where she hollows out a soft nest in the hay. When the hen is settled in her new home, a dozen eggs are put under her and she snuggles down on them and keeps them warm.

For three weeks she sits on the eggs, turning them in the nest so that they will be evenly warmed. At the end of this time, if you look in the nest while the hen is being fed, you will hear tiny, cheeping noises coming from the eggs.

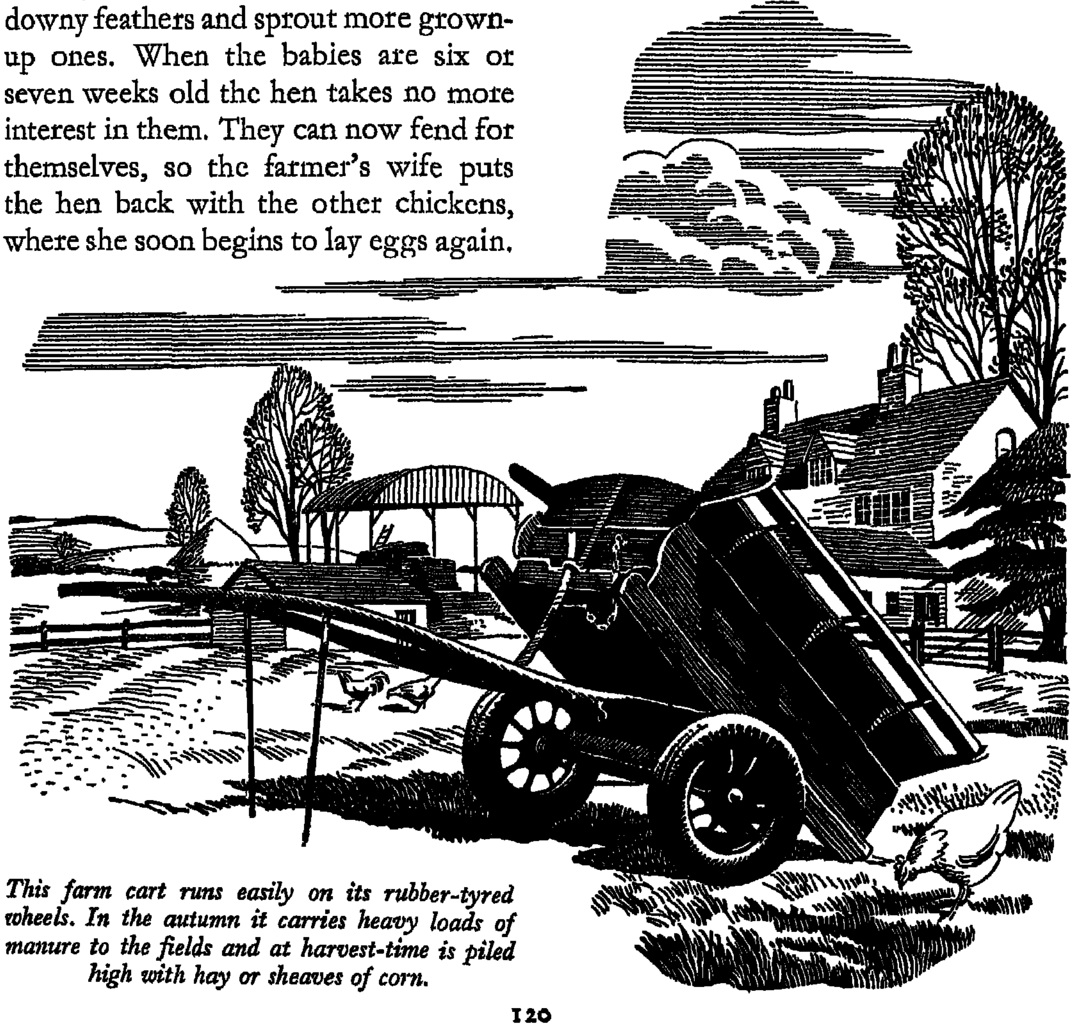


Though there are large poultry farms where the main concern is the production of eggs, a few chicken —and sometimes geese and ducks—are kept on most farms, often being cared for by the farmer's wife.

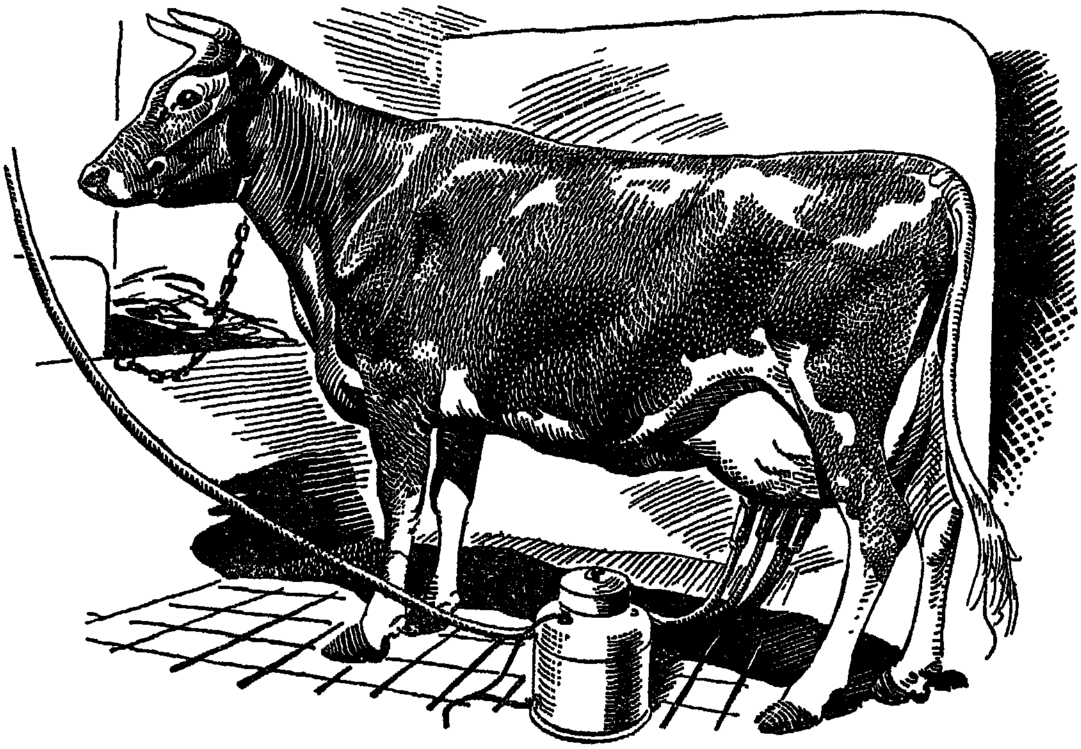
Some people put the eggs into warm water at this time, and those that jerk about as they float are returned to the nest. The others that do not jerk, for some reason, have not grown into baby chickens. Within a day or two all the eggs will have hatched, and if the weather is fine you will see the proud hen with her little brood around her. The youngsters still have a little yolk left in their stomachs, and so do not need food for a day or two. That is why young chicks can be sent by post.

Very soon the little chicks lose their downy feathers and sprout more grown-up ones. When the babies are six or seven weeks old the hen takes no more interest in them. They can now fend for themselves, so the farmer's wife puts the hen back with the other chickens, where she soon begins to lay eggs again. The youngsters go on growing, and by six months or so will be almost full-grown. Some breeds of fowl, like Leghorns and Minorcas, are called light breeds because they are light in weight. They lay many white-shelled eggs—as many as three hundred a year. The heavy breeds, like Indian Game, Light Sussex, and Dorking, are best as table birds, and lay perhaps only two hundred eggs. The Rhode Island Red makes a good table bird, and is a good egg-layer.

The main work of the farm is done



This farm cart runs easily on its rubber-tyred wheels. In the autumn it carries heavy loads of manure to the fields and at harvest-time is piled high with hay or sheaves of corn.



This cow is being milked by a machine which sucks out the milk in much the same way as a calf does. On some farms the last of the milk—or strippings, as it is called—is taken off by hand, but, properly used, the machine can milk the cow completely.

in the farmyard, the rickyard and the fields. In the farmyard the farmer looks after his cows, his pigs, horses, carts, tools, and machinery. There is a great pile of manure in the middle of the farmyard, and in the autumn he carts this manure on to the fields where he grows his crops. He never wastes this manure, for he knows that his crops will be better for it.

Along one side of the farmyard is a cowshed. The main part of the cowshed, where the cows are milked, is called the byre, and during cold winter nights the cows sometimes sleep in there, too. Nowadays many farmers milk their cows with a milking-machine which sucks the milk from the cow in much the same way as a calf does. The farmer keeps a few calves. These live in a special calf-house near the byre. It has an open run where the calves can scamper about in the daytime. Next to the byre is the dairy, where the milk is cooled and strained and put into churns or bottles. When the milk is ready, a lorry takes it away for distribution.

As you can see, the cowshed is an important place on the farm. Some farmers say that their cows pay their wages bill, and that they have to live on what they make out of the rest of the farm. So the farmer has to do other things besides keeping cows.

You will notice that he keeps pigs. They live in the pigsties, and part of each sty is roofed over as a kind of bedroom. The farmer sees that clean straw is always put in whenever it is needed. Do you notice that the cart-shed has no doors? This makes it easier to get the carts and wagons in and out. They are sturdily built, and only need to be protected from the worst of the weather.

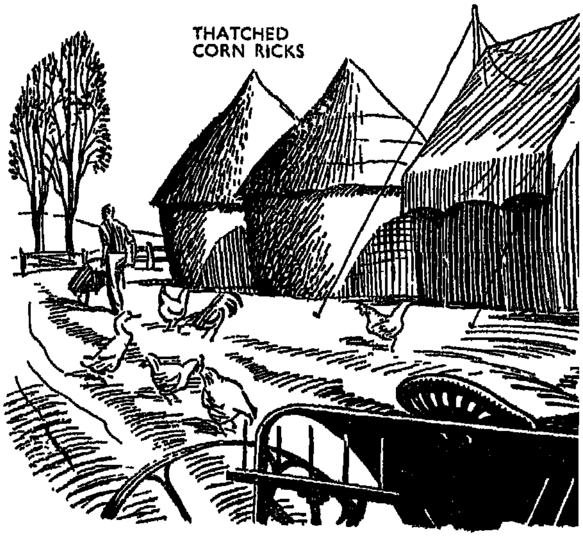
When the horses are not in the fields they live in the stables. Horses like lots of fresh air; so the doors of the stables are cut across the middle, in order that the farmer can open the "window" without the horse getting out. But the barn has the biggest doors of all. When these are open, the largest wagon, loaded high with sacks of corn, can be driven straight in. Then the farmer and his men set to work unloading it, putting the corn away in the barn. The great barn doors are cut in half, too. This is so that you can slip in and out by just opening the lower part.

When the farmer is not using his tools he stores them in a shed. Here he keeps his ploughs and haymowers and the machines he needs at harvest-time.

In the rickyard you can see a few hay ricks. This is because his Dutch barn is not big enough to take all the hay that the farmer has made. Over in the corner is a tall concrete tower called a silo. When the weather is too wet to make hay, the grass is made into cattle-feed called silage, which is stored in the silo. All through the spring and summer farmers are busy growing crops which they need to feed to their animals.

So let us stroll along the road and see what the farmer is growing in his fields. It is harvest-time, and the farmer and his men have been busy carrying the corn in the wheat-field to the rick by the gate, where it is stored. The field is now bare of corn, and all you can see are the short stalks of straw sticking up from the ground in long, straight rows. This stubble, as it is called, is all that remains of the wheat that was growing there. As soon as he can, the farmer will plough in this stubble, ready to take the next crop.

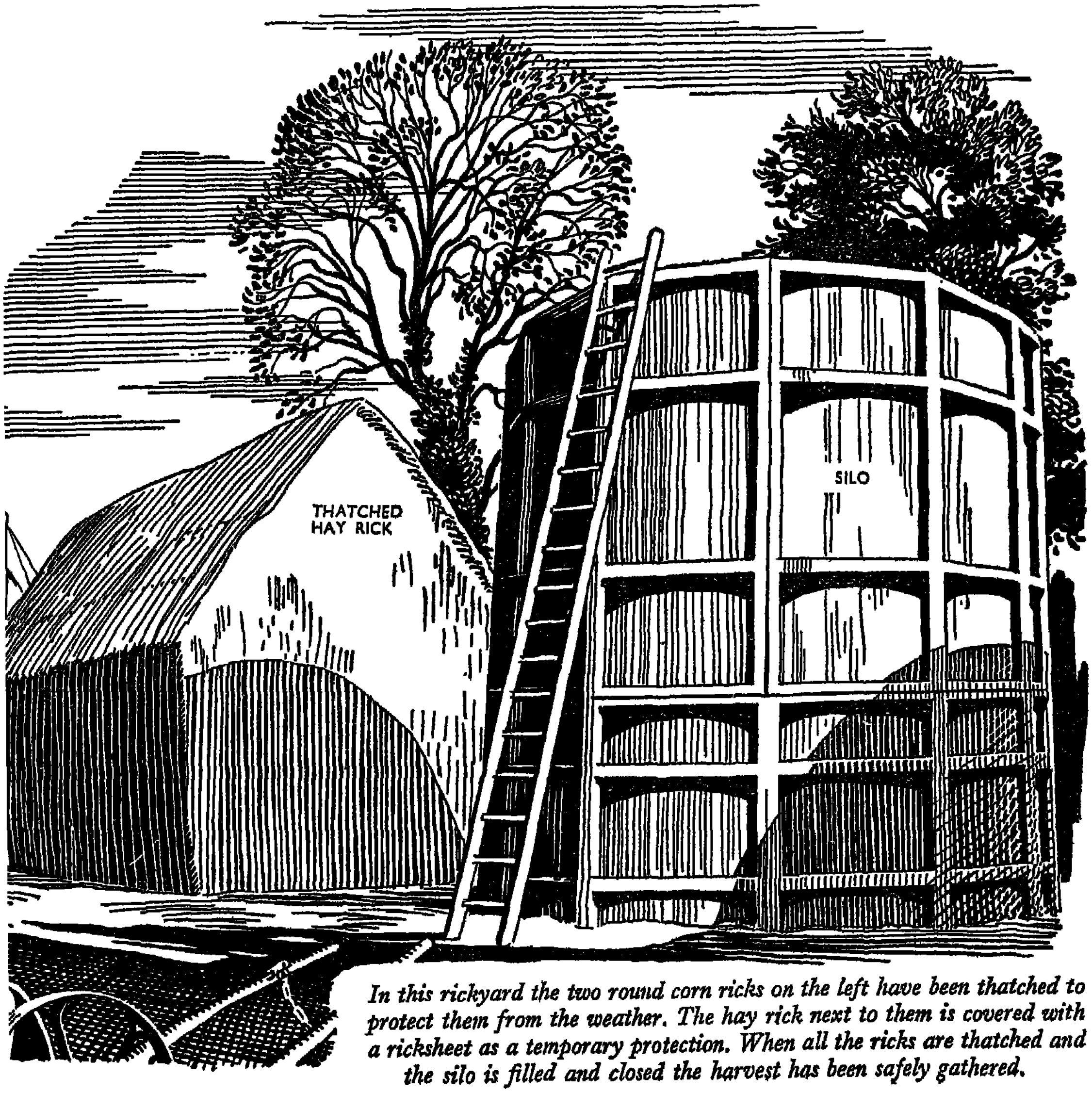
The oats in the next field have been cut and the sheaves of corn lie on the stubble. Some of the men are gathering the sheaves and standing them up, leaning against one another, to keep the ears of corn off the ground. This is called stooking, or shocking, the corn, and the stooks of corn stand in straight rows in the field. The wind and sun-



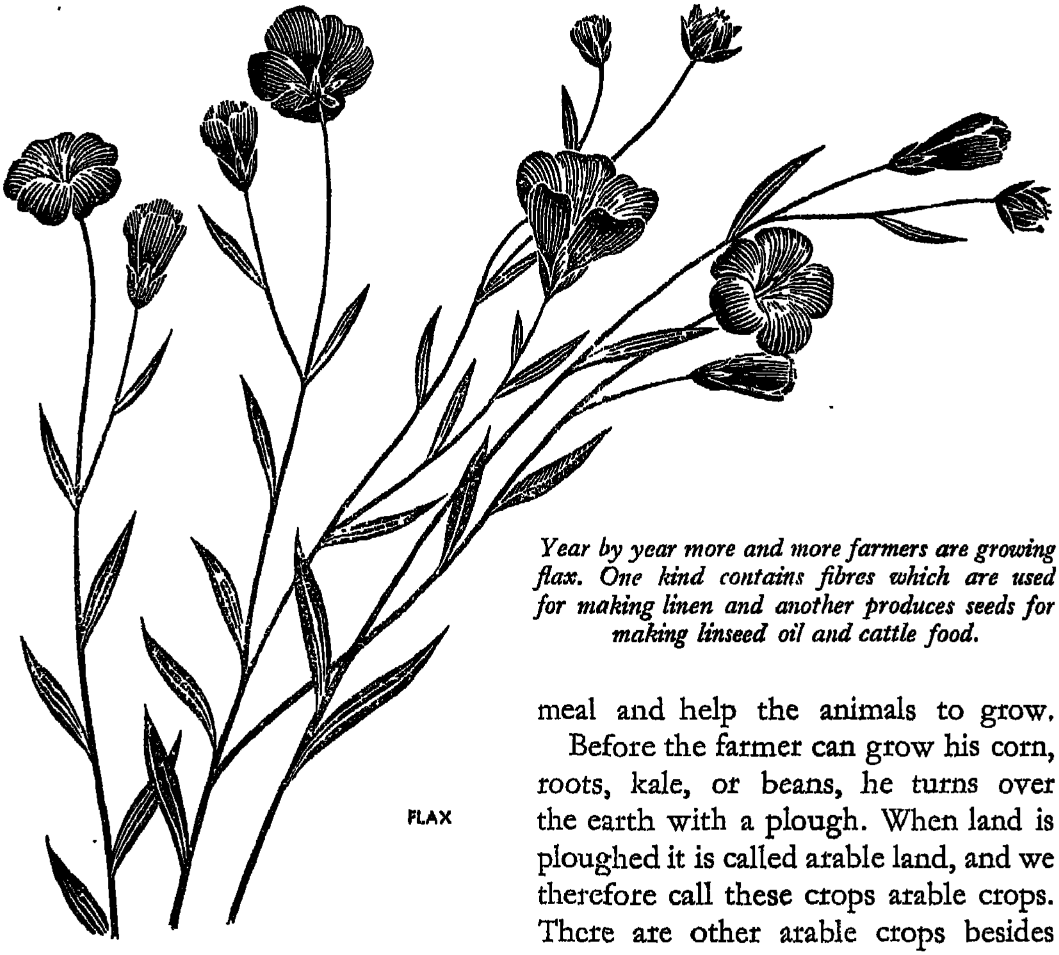
shine dry them and ripen them; and when they are ready they, too, will be carted away and ricked.

Most farmers grow a field or two of swedes, turnips or mangolds for the cattle to eat in the winter. These are called root crops. At harvest-time the root-fields are just a sea of green leaves. The leaves of swedes are greenish-grey, and look something like cabbage leaves. Turnip leaves have tiny white bristles all over them, but the leaves of mangolds are glossy and remind you of spinach.

You can tell when you are passing a field of kale because of the strong cabbage smell it has. Sometimes during the winter kale is fed to give cattle some greenstuff when they have finished the grass in the pastures and there is nothing left but dry hay. Cattle kale



In this rickyard the two round corn ricks on the left have been thatched to protect them from the weather. The hay rick next to them is covered with a ricksheet as a temporary protection. When all the ricks are thatched and the silo is filled and closed the harvest has been safely gathered.



FLAX

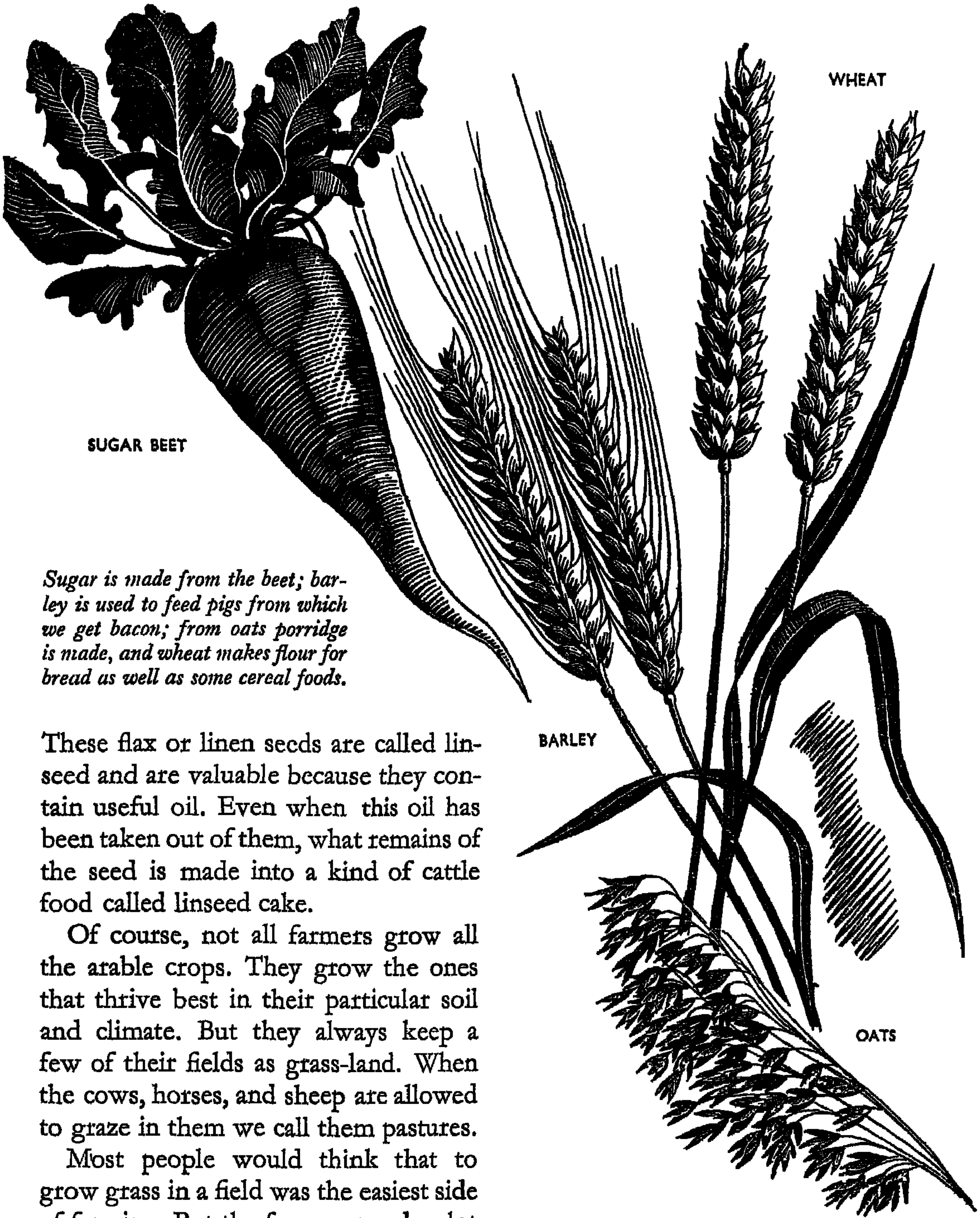
Year by year more and more farmers are growing flax. One kind contains fibres which are used for making linen and another produces seeds for making linseed oil and cattle food.

keeps fresh and green right through the winter, and is able to stand up to severe frosts. The cows like it, and it helps them to produce good milk.

One of the fields looks as if broad-beans were growing in it. These bean plants are like the broad-bean plants in our gardens, but the beans inside the pods are smaller, and we call them field beans. The farmer waits until the bean-pods are dry and nearly black. Then he cuts the bean-stalks just as he cuts the corn, and ricks them. The farm animals enjoy these field beans, especially in the depth of winter. They make a warming meal and help the animals to grow.

Before the farmer can grow his corn, roots, kale, or beans, he turns over the earth with a plough. When land is ploughed it is called arable land, and we therefore call these crops arable crops. There are other arable crops besides the ones we have seen. There is sugar-beet, for example, which is a root crop.

Some of the other arable crops that farmers grow are cow cabbages, field peas, vetches and clovers, which they also use to feed their animals on. Flax is an interesting crop that is sometimes grown. There are two kinds of flax, and both have blue flowers. One kind has a strong, stiff stem; it is strong and stiff because it has many tough fibres in it. These are the fibres that are used for making into linen. The stem of the other kind of flax is not as strong, but the plant produces good crops of seeds.



Sugar is made from the beet; barley is used to feed pigs from which we get bacon; from oats porridge is made, and wheat makes flour for bread as well as some cereal foods.

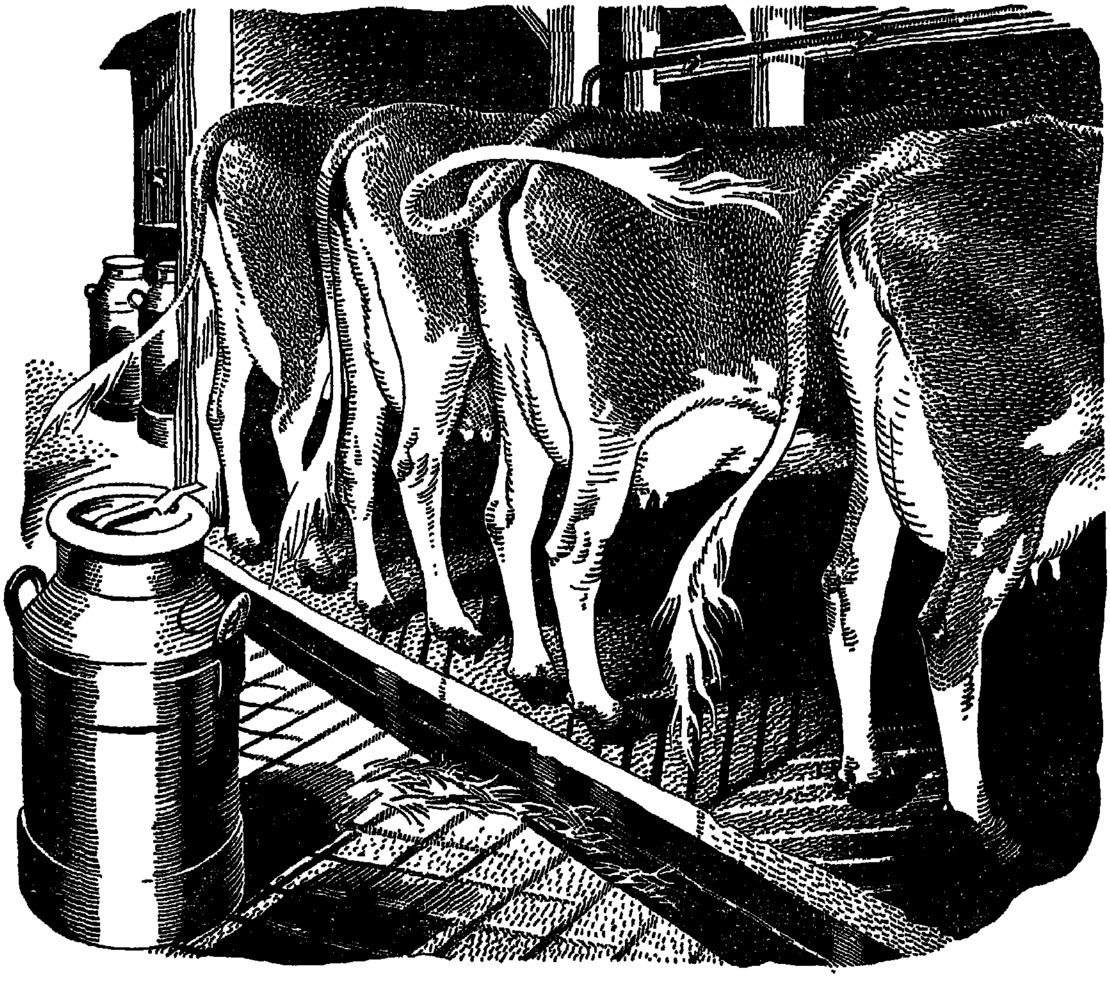
These flax or linen seeds are called linseed and are valuable because they contain useful oil. Even when this oil has been taken out of them, what remains of the seed is made into a kind of cattle food called linseed cake.

Of course, not all farmers grow all the arable crops. They grow the ones that thrive best in their particular soil and climate. But they always keep a few of their fields as grass-land. When the cows, horses, and sheep are allowed to graze in them we call them pastures.

Most people would think that to grow grass in a field was the easiest side of farming. But the farmer spends a lot of time and thought in looking after his grass. He has to decide when the grass in a pasture is getting too short for the cows feeding on it, and when it is time to take them out and put sheep in instead. The sheep, with their smaller mouths, nibble the grass that is too short for the cows, but the farmer must not leave the sheep grazing there too long. If he did they would spoil it, because they eat the tenderest grass.

So when you see a farmer leaning over a gate, idly chewing a straw and gazing at his land, remember that he is probably thinking very hard—thinking about his cows, his pigs, his horses, and his sheep; wondering if he should plough up this field and grow arable crops in it, or whether it would be better to leave it as grass for another year.

The farmer starts work early in the morning, seeing to his cows. During the summer the cows have slept out in a field, so out of the farm he goes and up



Clean milk is produced by clean cows in a byre which can be washed down with running water. A channelled floor, like the one shown here, is easy to clean and it also saves the cows from slipping.

For the first few days of its life a calf sucks milk straight from the mother cow. Then it is given its milk in a bucket which the farmer has to hold securely while the calf has its drink. Soon the calf will begin to eat grass, hay, and other foods.

the road to fetch them, leading them back to the farm and through the farmyard to the byre, where each cow has her own place at the manger. She goes straight to it, and while she is eating her breakfast of hay and cattle cake or ground-up oats the men wash her with warm water so that she is clean and ready for milking. During her breakfast she drinks from the water-trough by the manger. Cows that are giving milk drink lots of water—perhaps as much as thirty gallons a day.

Soon there is a clatter of milking-pails as the men get ready to milk the cows, and then it gets quieter in the byre, the cows sigh contentedly as they eat their breakfast, and the milk gurgles along the rubber pipes of the milking-machine into the buckets. The men carry the full milk-buckets from the byre into the dairy, where it is weighed. It seems odd to think about milk being weighed, but this is easier than measuring it. You just hang the bucket on the hook of the weighing-machine and read the scale, but to measure it you would have to pour the milk into measuring churns, and some of it might be spilled.

The dairy is a bright, clean place. It has white, gleaming walls, and a wide sink with hot- and cold-water taps for washing the milking apparatus. The warm milk from the cow would not keep—especially in the summer—unless it were cooled. So after it has been weighed it is strained and run over a rack of hollow pipes which have cold water running through them.

All this work is done before the farmer and his men have thought about breakfast, so you can imagine how ready they are for the first meal of the day. But first someone has to take the cows back to the field, and also the calves must be fed, so one of the men takes some uncooled milk along to them.

FEEDING YOUNG CALVES

The baby calves receive warm milk straight from the cow, but as they get old enough to be taken from their mothers the cowman teaches them to feed from a bucket. At feeding time he takes a bucket of warm milk into the calf-pen. At first the little calf does not know what to make of this. It cries piteously, and looks round for something soft to suck. So the cowman lets it suck his finger. (If you do this, you will feel how rough even a very young calf's tongue is.) While the calf sucks his finger, the cowman gently lowers his hand into the bucket, and the calf's mouth is pulled into the milk. The little calf has quite a shock to find milk down there, because until then it had been used to *lifting* its head when it wanted a drink. So there is a good deal of sneezing and bubbling in the bucket at first, but it soon gets used to it.

The male calves are called bull calves, and the females are called heifer calves. They are known as heifers until they have grown up and had their second calf. Then they are known as cows. When a cow or heifer has a calf she is rather fierce at first, and moos plaintively if anyone comes near.

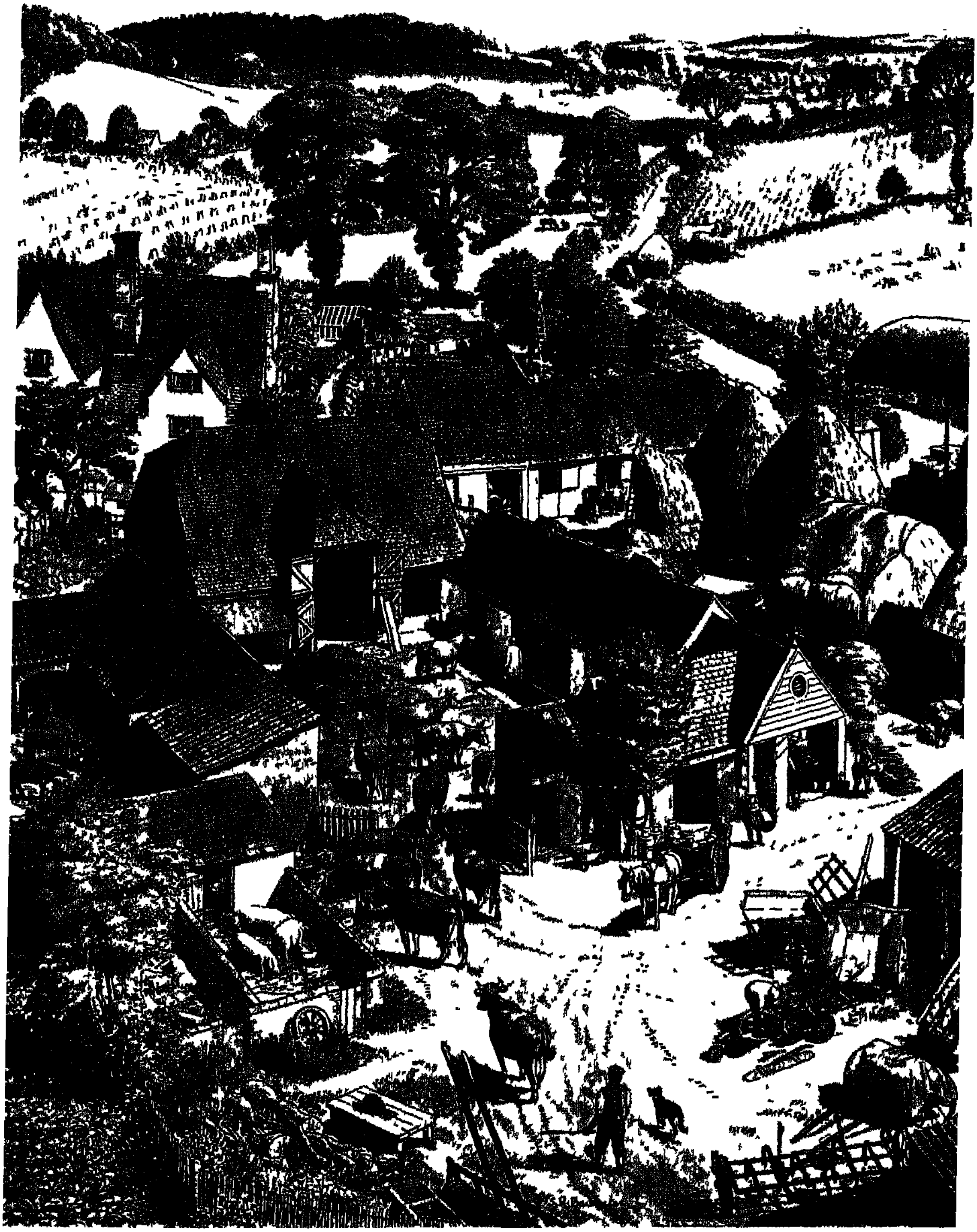
Most of the cows that the farmer milks belong to one of the dairy breeds. These are the heavy milkers, and a good dairy cow will give ten thousand pounds, or more, of milk a year. But some breeds do not milk heavily; they are kept for the beef they produce. These beef breeds are all powerful animals, and in olden times provided the farmer with oxen to draw his ploughs and carts. Nowadays this work is done either by horses or, on up-to-date farms, by tractors.

The farmer can also get meat from his land by keeping sheep, to produce mutton and lamb, and he gets wool from the sheep as well. Different breeds lamb at different seasons, principally October and March. The ewes are sometimes out in the pastures until a month before lambing. The shepherd is looking after them, and the farmer knows that if the winter grass is not enough to feed them the shepherd will give them some hay or turnips.

LAMBING SEASON

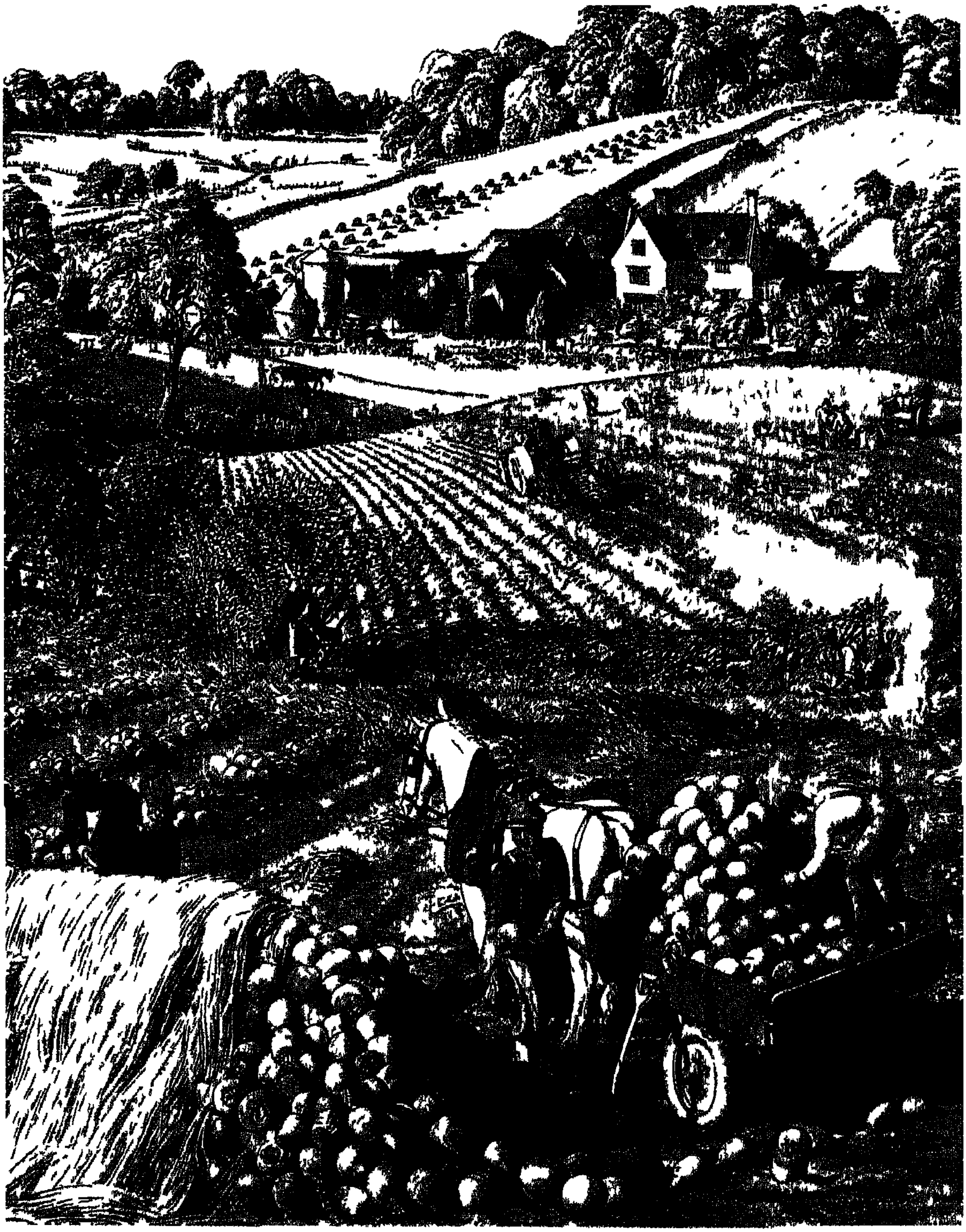
Shepherds make their lambing-pens in a sheltered corner of the field, of great bales of compressed straw. The lambing-pen has a roof over it, but one side is left open so that the ewes and their lambs can be looked after, and there is plenty of clean, dry straw in it.

Then the great day arrives. The first lambs are born, and fresh straw for the pens, hay and roots for the ewes, and



WORK ON THE FARM IN LATE SUMMER

Cutting, stooking and ricking the corn, thatching ricks, for which the straw is first wetted to make it pliable, and repairing the farm implements, among which a two-share plough and disk-harrow can be seen, are among the varied activities of the season. On this farm the dairy herd consists of Guernsey cows, famous for their milk yield.



WORK ON THE FARM IN THE AUTUMN

Mangolds are being built into a clamp for storage through the winter. Hedges are being trimmed and ditches cleaned in preparation for the winter storms. Potatoes are being lifted. On fields which have been harvested, manure is being spread to enrich the ground for next year's sowing and fallow land is being ploughed for the sowing of winter wheat.

milk for any orphan lambs, have to be taken to the hill. Everybody helps, because they know that the shepherd is tired. He has been up all night, for it is during the night that most lambs are born. Some of the ewes have had one lamb (or a single, as it is called), but many of them will have had doubles.

LAMB-CREEPS

The lambs live on their mothers' milk, so if any of the ewes die another mother must be found for the baby. This is only possible if there is a ewe whose lamb has died. The dead lamb is skinned, and the skin is put over the orphan lamb, which is given to the new mother. She accepts it and feeds it, because it brings with it the scent of her lost baby. As the lambs get older they need more than just their mothers' milk, so the shepherd puts out some juicy turnip-tops, corn or cake for them to nibble at. He fences off this food behind hurdles that have low, small gaps in them. These hurdles are called lamb-creeps, because the lambs can creep through the holes, but the ewes cannot.

Soon the lambs must have their long tails docked or they get dirty and harbour disease. Docking hurts the lambs for a little while, but they soon get over it and are all the better for it.

Lambs grow fast all through the spring and summer, and by the winter are much more sedate and sheep-like. They are now known as tegs (or hogs), and by the following May or June their wool is thick enough to be sheared.

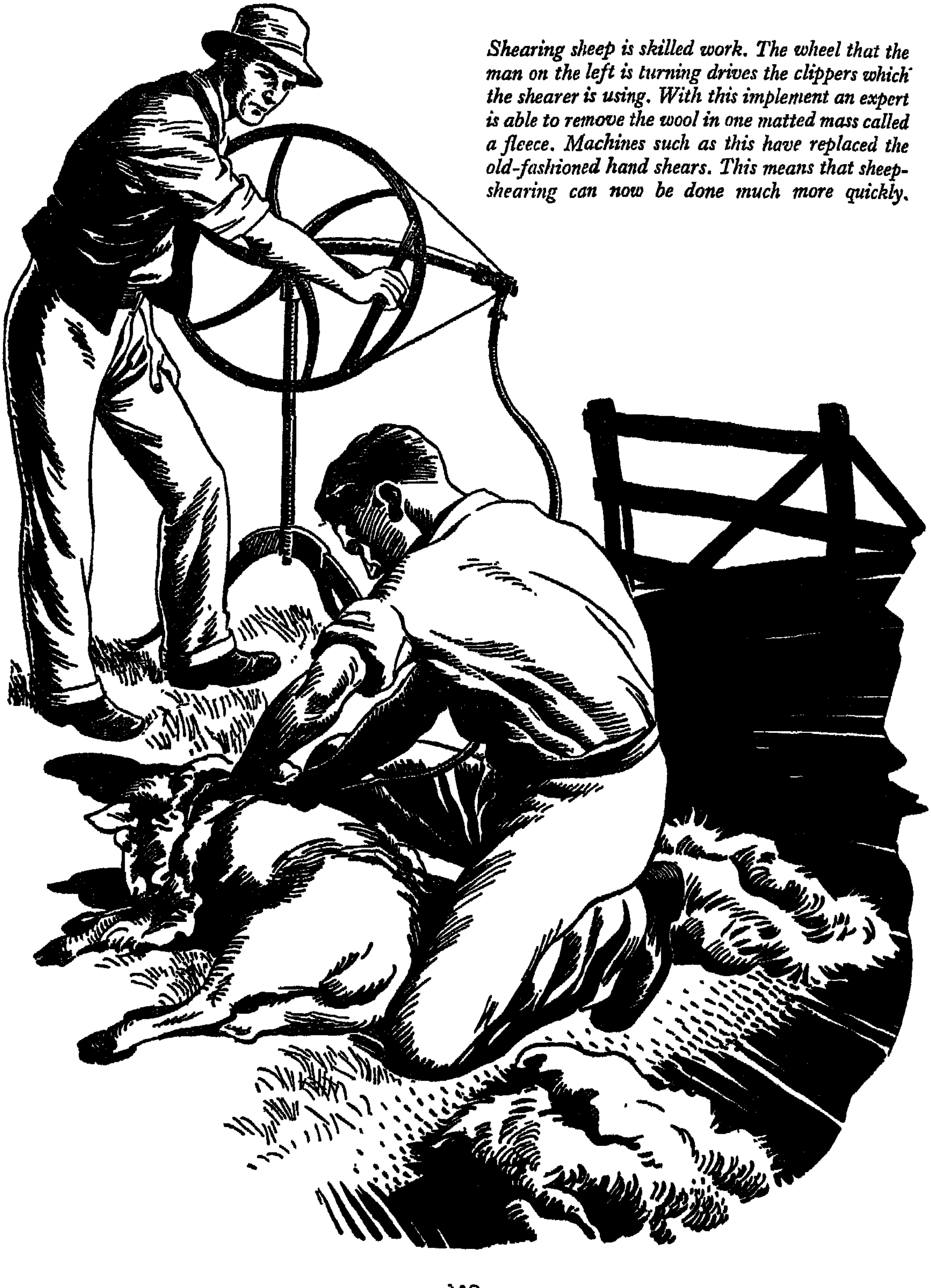
To see the tegs being sheared is a wonderful sight. They are brought into the pen, and the matted wool is clipped off all in one piece, and is then called a fleece. After shearing, the sheep are called shearlings, though some people call the ewes gimmers or theaves. The shearlings look rather lamb-like as they get up and escape from the shearer.

About three weeks later they are dipped. This is done by giving them a ducking in a special liquid that protects them from flies, ticks, and mites, all of which cause skin diseases. One by one the sheep are dragged to the edge of a huge tank sunk in the ground. They are pushed in and flounder about in the liquid, trying to get out. But instead of helping them the men push them right under, so that their heads are wetted. Only then are they allowed to scramble up the side of the tank and escape.

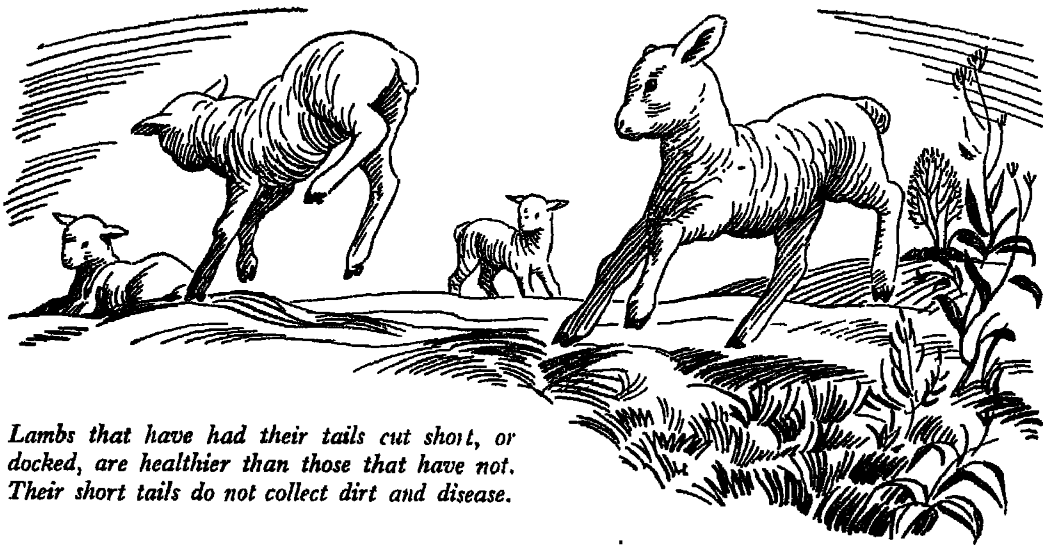
Just as the different breeds of cattle are noted for their meat or their milk, so sheep are well known for either their meat or their wool. The longwool breeds are mostly large sheep with a good fleece, the shortwool breeds do not give so much wool, but produce excellent mutton, as do the hardy mountain breeds.

CHEWING THE CUD

Now, neither sheep nor cows have front (or incisor) teeth in their upper jaws. They, therefore, do not bite in the way that other animals can. Instead, their lower incisors bite against a horny pad at the front of the upper jaw. So that when they graze they really tear the grass, rather than bite it. This grass is swallowed straight away, and goes into the first part of the animal's com-



Shearing sheep is skilled work. The wheel that the man on the left is turning drives the clippers which the shearer is using. With this implement an expert is able to remove the wool in one matted mass called a fleece. Machines such as this have replaced the old-fashioned hand shears. This means that sheep-shearing can now be done much more quickly.



Lambs that have had their tails cut short, or docked, are healthier than those that have not. Their short tails do not collect dirt and disease.

plicated stomach. Later on it comes back into the mouth, where it is chewed thoroughly and then swallowed again. This is called chewing the cud, and animals that do it, like cows and sheep, are called ruminants. The farmer uses them, so to speak, to turn grass and other crops into milk, meat and wool.

Farmers keep pigs to produce pork or bacon. Mother pigs (or sows) have more babies than the other farm animals, and when a sow farrows (as having little pigs is called) the farmer hopes that she will have at least eight. She lies in the sty on clean wheat straw that she has chewed into little pieces, and her wriggling babies snuggle up to her. For three weeks they feed on her milk, then the farmer gives the piglings a little trough of food of their own, and they soon learn to feed as greedily as their mother. When they are about eight or nine weeks old they are taken away from the sow and grow steadily on the good food that the farmer gives them. By the time they are about six months old they may weigh as much as six score pounds and are known as porkers. But if the pigs are wanted for bacon instead of pork, the farmer waits until they weigh eight or nine score before he sends them to market.

Many farmers give their pigs boiled potato peelings and left-overs from the table and kitchen. This is called pig swill. It is good food if kept clean and free from disease. Unfortunately, this was not always so, and unhealthy swill was commoner in the warmer months than at any other time. So some people will eat pork only when there is an "r" in the month—that is, from September until April. But now pigs must by law be given wholesome swill.

We all love the farmer's horses. They are so strong and yet so gentle, so hard-working and so patient. The farmer treats his horses as friends, and often talks to them as though they were human. But in the old days the heavy work on the farm was done by oxen. These slow, powerful beasts could pull

Many farmers are glad to keep pigs because they can feed them on much that is unsuited to other farm animals and they provide pork and bacon.

the old-fashioned massive ploughs, but when lighter ploughs were invented horses replaced oxen and the work was done more quickly. The English shire-horse, which many farmers use, is descended from the old English war-horse. He had to be strong enough to carry a rider in full armour, but the shire-horse of today is stronger and, having a broader hoof, does not sink so much into the muddy fields.

In the days before tractors there was hardly a job on the farm where the horses could not help. But today much of the farm work is done by machinery, and horses are disappearing from the land, as oxen did before them. Even so, farmers are very attached to their horses and there is always much excitement when a new one is born. When the farmer realizes that one of his mares is before long to have her baby foal, he sees that she is brought into the stable to sleep, even in the summer. When the foal is born he makes a great fuss of her and gives her the best food to help her make milk for her baby. If her foal is a son it is called a colt; if a daughter it is known as a filly. You will notice how long the foal's legs are. This is because foals have to be tall enough to take their mother's milk even when she is standing up.

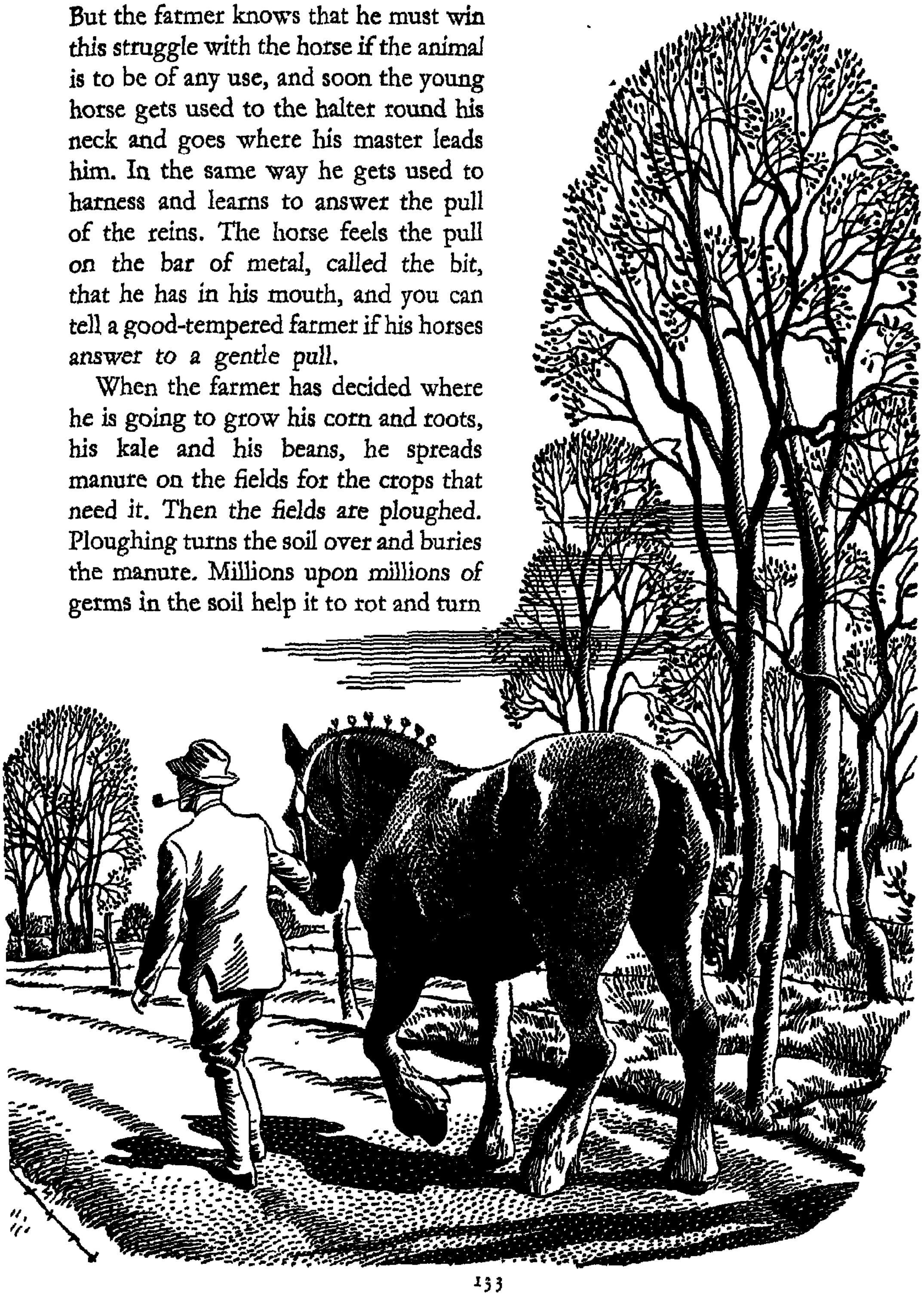
The farmer takes the foal from its mother when it is about four months old, and sometimes puts it to run with the cows. The company of the other animals keeps it cheerful.

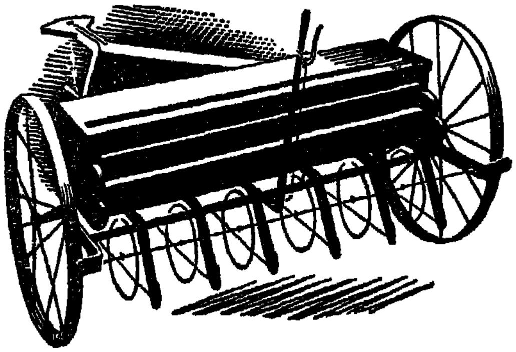
But horses cannot play all their lives, and when they are about two years old the farmer gets them ready for work. He first puts a rope round the young horse's neck. This is a new experience, and the horse often struggles against it.

Though horses are used on farms less today than in years gone by, all farming folk are fond of them. The horse which the farmer in this picture is leading is a shire, a type descended from the old English great horse, valued in olden times because it was strong enough to carry the enormous weight of an armoured knight. The modern shire is one of the chief agricultural horses in England.

But the farmer knows that he must win this struggle with the horse if the animal is to be of any use, and soon the young horse gets used to the halter round his neck and goes where his master leads him. In the same way he gets used to harness and learns to answer the pull of the reins. The horse feels the pull on the bar of metal, called the bit, that he has in his mouth, and you can tell a good-tempered farmer if his horses answer to a gentle pull.

When the farmer has decided where he is going to grow his corn and roots, his kale and his beans, he spreads manure on the fields for the crops that need it. Then the fields are ploughed. Ploughing turns the soil over and buries the manure. Millions upon millions of germs in the soil help it to rot and turn





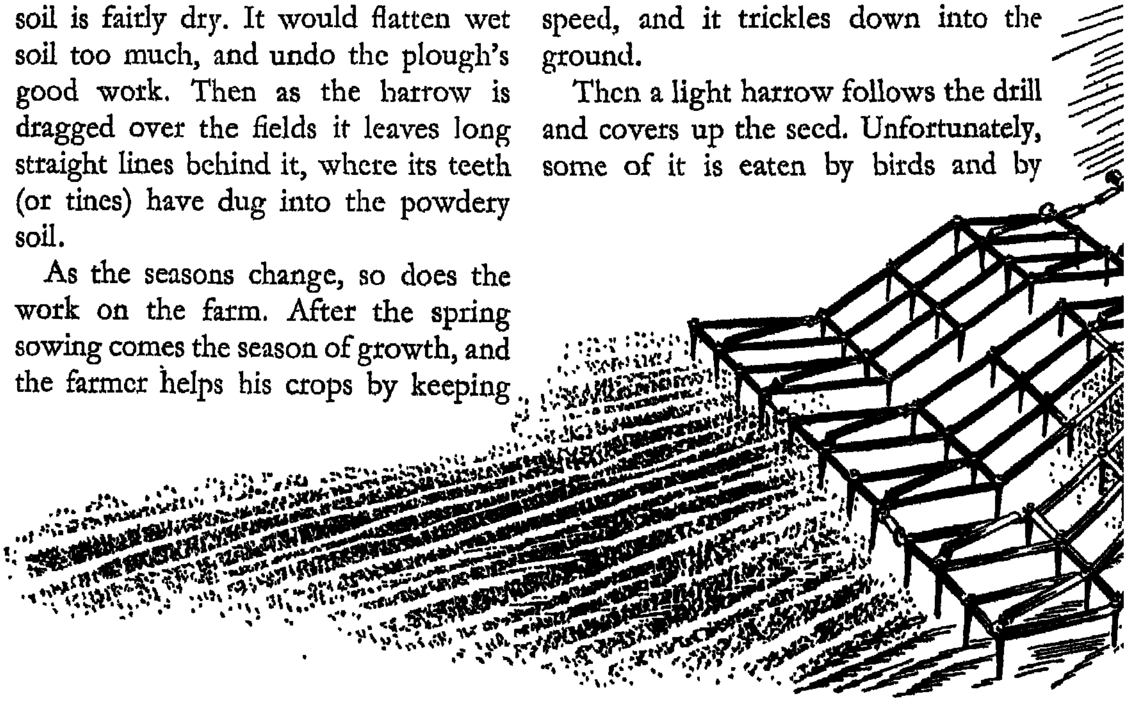
This seed drill has six spouts and can, therefore, sow six rows of corn at a time as it is towed over the fields by horse or tractor.

it into useful mineral plant foods that the crops can use. But the land must now be crumbled down so that seeds can be sown in it. If the ploughing has been done in the autumn, the winter weather will help a great deal. But to make a good seedbed, the land is rolled and harrowed. A roller is used when the soil is fairly dry. It would flatten wet soil too much, and undo the plough's good work. Then as the harrow is dragged over the fields it leaves long straight lines behind it, where its teeth (or tines) have dug into the powdery soil.

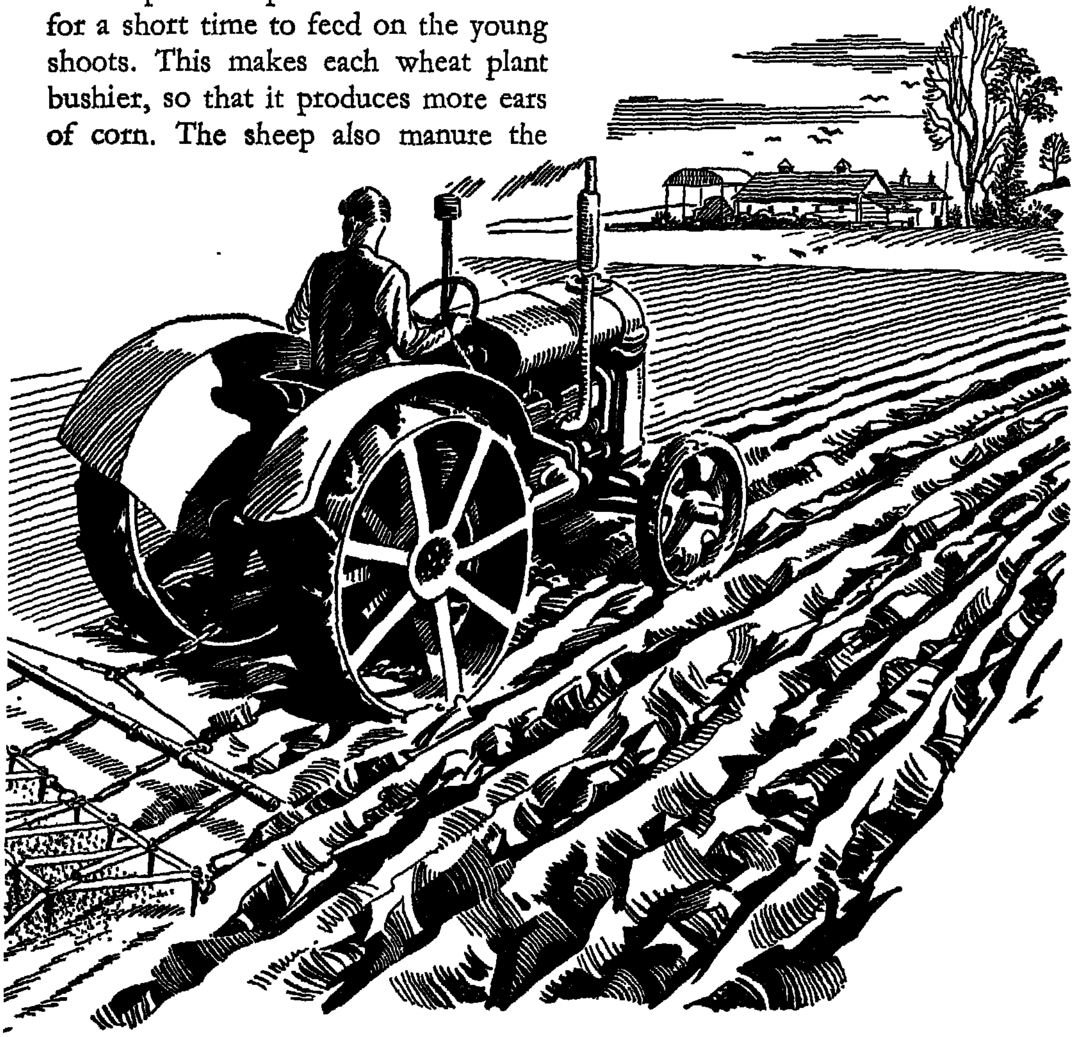
As the seasons change, so does the work on the farm. After the spring sowing comes the season of growth, and the farmer helps his crops by keeping them free from weeds. Then in the summer he gathers the harvest, but his work goes on into the winter, threshing the corn and ploughing for the next year's crops.

Most farmers, however, sow their wheat and beans in the autumn. Oats and barley are usually sown in spring, and mangolds shortly after. But swedes, kale, and turnips wait until May or June, and it may be July before the last of the turnips is sown. The machine that sows the seed is called the seed-drill. It is a long box on wheels, and contains the seed. The box has a row of tubes, called spouts, reaching down to the ground, and inside the box is a row of toothed wheels, one for each of the tubes. As the drill goes along, its wheels turn round and make the toothed wheels turn, too. The teeth therefore force the seed into the spouts at just the right speed, and it trickles down into the ground.

Then a light harrow follows the drill and covers up the seed. Unfortunately, some of it is eaten by birds and by



creatures that live in the soil, but soon, when the farmer looks at his fields, he sees long straight rows of green seedlings poking up through the soil. A field of corn at this time might easily be mistaken for a field of grass, until you notice that the green blades are in straight rows. The wheat and beans never grow much more than this during the winter, and in the early spring the farmer puts sheep into the wheat-field for a short time to feed on the young shoots. This makes each wheat plant bushier, so that it produces more ears of corn. The sheep also manure the wheat, and their hooves press the soil round any plants that have been loosened by the winter frosts. Then in the warm spring sunshine the wheat and beans begin to grow again. The spring-sown crops are growing nicely, too, but so are the weeds. So, for the root crops, the farmer takes the horse-hoe along the rows of plants. It tears the weeds out of the ground and leaves them lying on the



The field has already been ploughed. Now the tractor drags the harrow over the furrows, crumbling the soil in preparation for the sowing of the next crop.

top to die. Many farmers also kill the weeds by spraying the fields with weed-killer. This liquid lies on the flat leaves of the weeds and kills them, but slips off the upright blades of corn which are therefore unharmed.

THINNING SEEDLINGS

Seeds of all root crops are deliberately sown too thickly so that the rows of seedlings show up well. As soon as they are up, the men go into the fields with hoes, chopping all the seedlings down, except one every nine inches or so. This thinning gives the remaining seedlings a chance to grow into nice big plants, and thinning (or singling, as it is called) the roots is a skilled job. Most farmers do not, however, thin their kale. This is because unthinned kale produces more leaf and less stem than thinned kale, and it is the leafy part of the kale that is so good for the cattle during the winter.

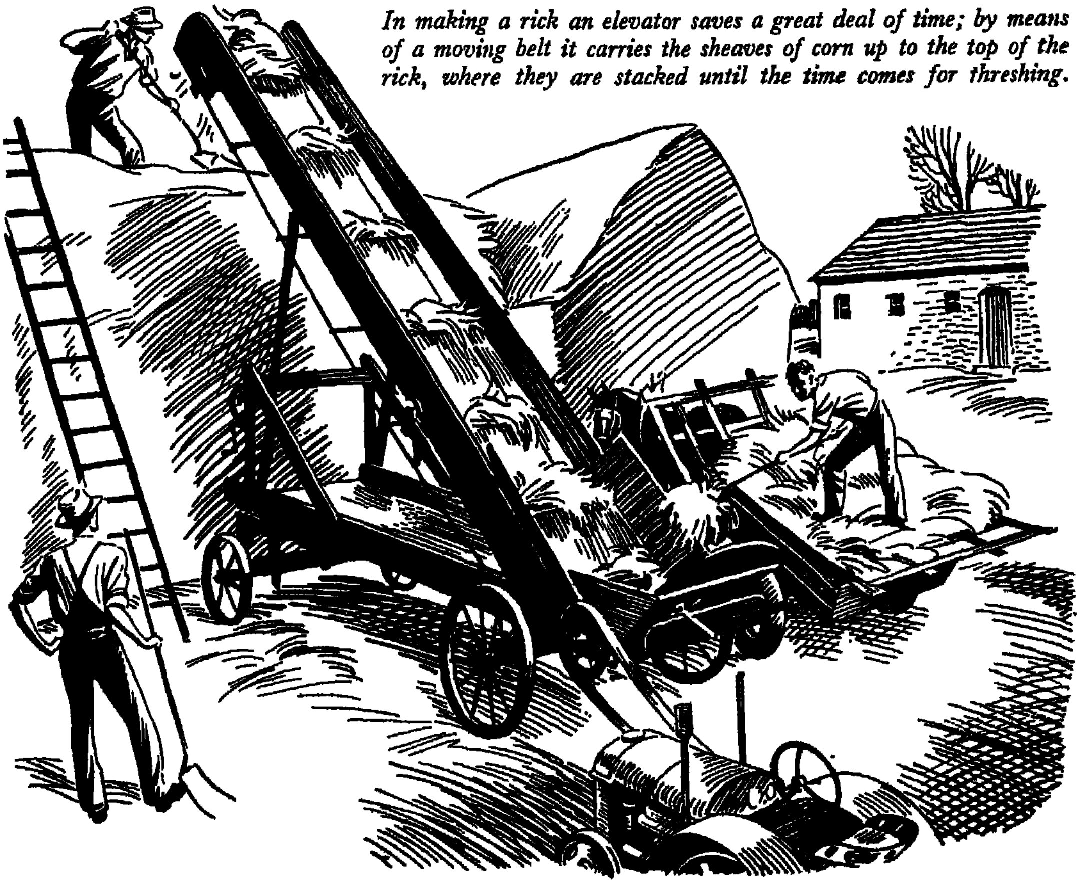
August usually sees the beginning of the corn harvest. The wheat and oats are cut almost as soon as the field has changed from green to yellow, before the grain is hard and ripe. But the farmer waits until the barley is dead ripe before he sends his men into the fields to cut a way round the corn with scythes. When this way has been cut there is room for the corn-binder to get to work. A corn-binder is a wonderful machine that does the job far more quickly than could men with scythes. As it goes round the field you can see on it things like windmill sails revolving. This is the reel, which bends the corn-stalks over, so that, as they are cut they fall on to the platform of the binder. This platform is really a moving canvas belt that carries the corn up a slope to the deck of the binder. Here another part of the machinery packs it into sheaves, tied round with twine. All this happens as the binder steadily chugs its way round the standing corn! The sheaves of corn are thrown out, and the binder rolls along, cutting many acres of corn a day. You can guess how long it would take men with scythes to do this! The corn is stooked, and when it is dry the men load it into carts and take it to a corner of the field near the gate, or to the rickyard, where they build the rick.

MAKING A RICK

On some farms the sheaves are hoisted on to the rick with pitchforks, but this is very heavy work, and rick-building is easier if the farmer has an elevator. An elevator has a long moving band with hooks on it and, as the sheaves of corn are tossed on to its lower end, the hooks carry them up to the top of the rick, and as the rick gets higher the elevator is raised more and more, so that the corn is always delivered to the top. When the rick is built and thatched the farmer heaves a sigh of relief, for his corn is safe and he can get on with the rest of the harvest. On some farms, especially those with large fields, a combine harvester is used. This machine cuts off the ears of corn, knocks the grain out of them and fills it into sacks. This machine saves much time and trouble, but the grain so produced has to be dried with great care. When the root crops are ready the men pull them up by their leaves. They trim off the leaves, and make a long heap of the roots in a corner of the field. The heap is covered with a thick layer of straw, and then with soil to protect the roots from frost until they are needed. This great long mound is called a clamp, and potatoes are often clamped in this way, too.

The harvest is home, the work of the year is done, but the farmer and his men cannot rest. They must soon plough for the next harvest, and the corn in the ricks must be threshed. The threshing-machine is even more wonderful than the binder. This great box on wheels has a hole in the top where the sheaves of corn go in. Inside, a great whirling drum rattles the corn-grains out of them. All the dust, straw and weed-seeds are sorted and come out at different places. The threshing-machine even sorts the grain into different qualities, which come out of separate spouts, and are collected in sacks.

While this is going on the farmer is planning his next year's work. He knows that his crops feed on the minerals in the soil and that different crops use up somewhat different minerals. So to get the best out of his land he changes his



In making a rick an elevator saves a great deal of time; by means of a moving belt it carries the sheaves of corn up to the top of the rick, where they are stacked until the time comes for threshing.

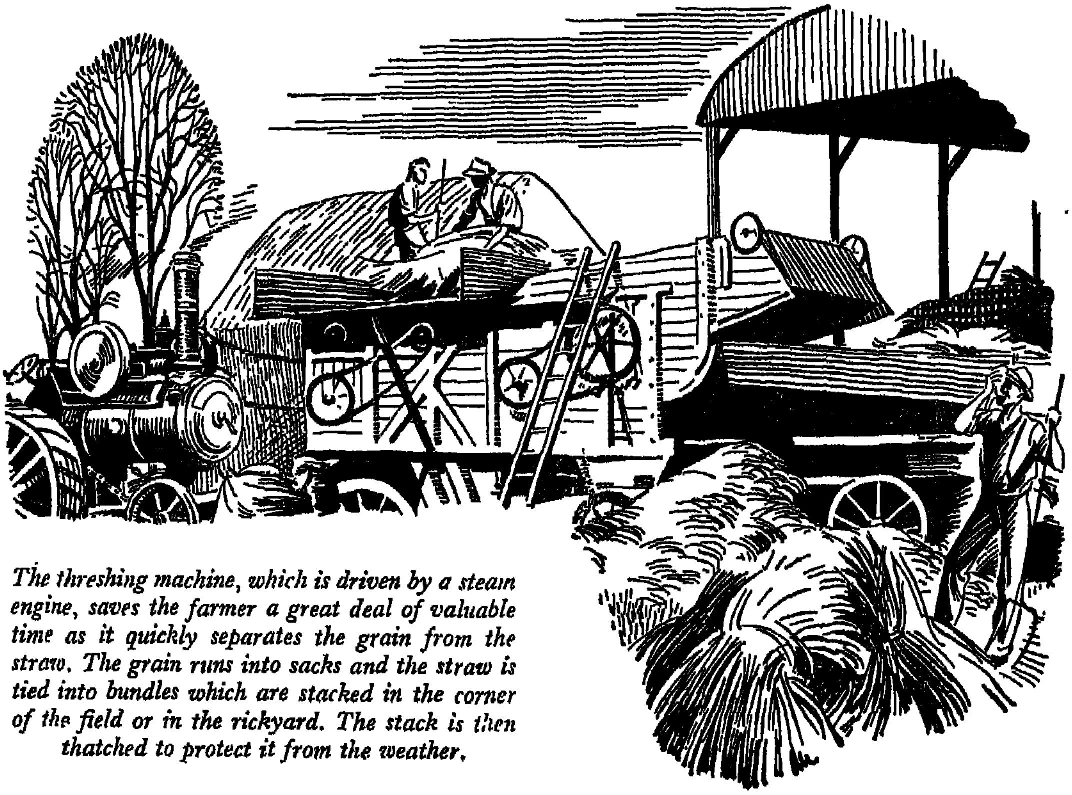
crops about from year to year. Rotating the crops in this way will work for a few years, but the minerals would be used up if manure were not added.

Another way of enriching the soil is to grow crops of peas, beans, and clovers. The roots of these crops become infected with a germ that actually helps them to feed on the nitrogen of the air in a way that other plants cannot. So that when these crops are eaten and are returned to the land as manure they enrich the land with nitrogen which the other crops can now use.

Arable land is also sometimes sown to grass to enrich it. Then the animals grazing on it manure the ground which later yields good crops. The heaviest crops often come in when land that has been grass-land for many years is ploughed.

You have probably admired the buttercups and daisies in a pasture, but did you know that the buttercups are poisonous to cattle? So the pasture is poor if it has them in it and it means that if a field has in it large patches of weeds like buttercups, daisies, nettles, docks, and thistles, the wise farmer will plough it to take arable crops for a year or so. The ploughing and cultivation of the arable kills most of the weeds, and makes it fit to sow grass again.

If you look at a grass-field at hay-time, when the grasses are in flower, you will notice that there are several different kinds of grass. The grasses that most farmers like to see on their land are

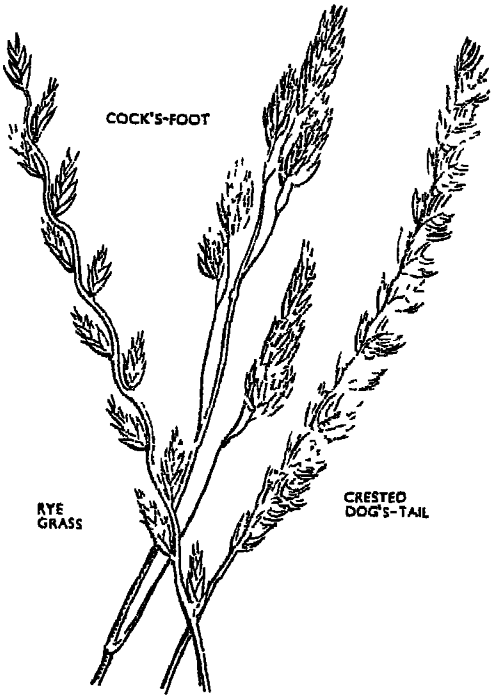


The threshing machine, which is driven by a steam engine, saves the farmer a great deal of valuable time as it quickly separates the grain from the straw. The grain runs into sacks and the straw is tied into bundles which are stacked in the corner of the field or in the rickyard. The stack is then thatched to protect it from the weather.

rye grass, cock's-foot, crested dog's-tail and some others, according to the kind of soil. The different clovers, too, are useful food, and sometimes whole fields are sown with clover, which is made into hay. Hay is cut when the grass and clover are in flower, before they have gone to seed. It therefore has the food in its stalks, and not in its seeds, which the animals would not eat. As the haymower goes round the field the grass falls in long swaths behind it. There it lies, drying in the sunshine, and the men come along and shake it out, so that it will dry more quickly. This is called tedding the hay. As soon as it is dry, or "made," it is collected up before a sudden shower wets it again. For this purpose a hayrake collects the swaths together into long heaps known as windrows. The hay is then loaded into carts and carried to the rickyard.

If the summer is too wet to make much hay, the farmer makes silage as well. To make silage, young leafy grass is cut with the haymower, but instead of being dried it is carried straight to the silo and packed down in it. As each load of grass goes into the silo, it is sprinkled with water sweetened with a special kind of treacle. This helps to preserve it, and the cattle are especially fond of it.

In addition to arable and grass, many farmers grow fruit. They may grow it just for themselves or, if their land is suitable, they have large orchards of apples, pears, plums or cherries. All these fruit-trees bloom in the spring, and an orchard at blossom time is a glorious sight. The pollen is carried from flower to flower by the bees so that fruit will form. But if the spring frosts damage these flowers they will not turn into fruit. Now, the cold air that causes frosts is heavier than warm air, and therefore rolls downhill. That is why an orchard high up on a hillside is usually safer from frost than one in a hollow.



The fruits swell during the spring and summer, and when they are ripe the farmer sends the fruit-pickers into the orchard with long ladders and baskets. Apples and pears usually go to market, but some of the plums go to a factory to be made into jam.

In the autumn and winter, when the leaves have fallen, the fruit-trees are pruned by cutting off dead stems and branches and some of the live branches and stems as well, if they are too crowded, because good fruit-trees have the branches well spaced, so that the sun and air can get into the heart of the tree and ripen all the fruit.

It is during the winter, too, that the farmer sprays his fruit-trees to destroy the eggs of insect pests that attack them. These sprays destroy the eggs of greenflies, but it is the caterpillars of winter moths that do most damage by eating the leaves of the fruit-trees, and as sprays will not kill the eggs they have to be dealt with in other ways. The female moth climbs up the trunk of the tree in the autumn to lay her eggs in the branches. She cannot fly, so the farmer ties bands of sticky paper round the tree-trunks and traps her there, and sometimes you may find hundreds of these wingless female moths sticking to the grease-bands round tree-trunks.

So when we walk round a farm and see the animals, the crops, how the farmer does his work and the way he has to plan it, let us always remember to help and not to hinder, and to close the gate behind us.

This man is using what is known as a "knapsack" sprayer to destroy the eggs of greenfly that live in the crannies in the bark of fruit trees. The bands of paper round the trunks of the trees are sticky and trap the winter moths as they crawl up to lay their eggs. Trees that are treated in this way in winter are not attacked by greenfly or moth caterpillar in the summer.

Insect life

MOST PEOPLE, at some time or other, have watched insects going about their work. Insects always appear to be so busy and so intent on what they are doing. They never seem to have time to play, but go seriously about their business, as though their lives depended on it. As a matter of fact they do, since, as we shall see, every insect has its enemies.

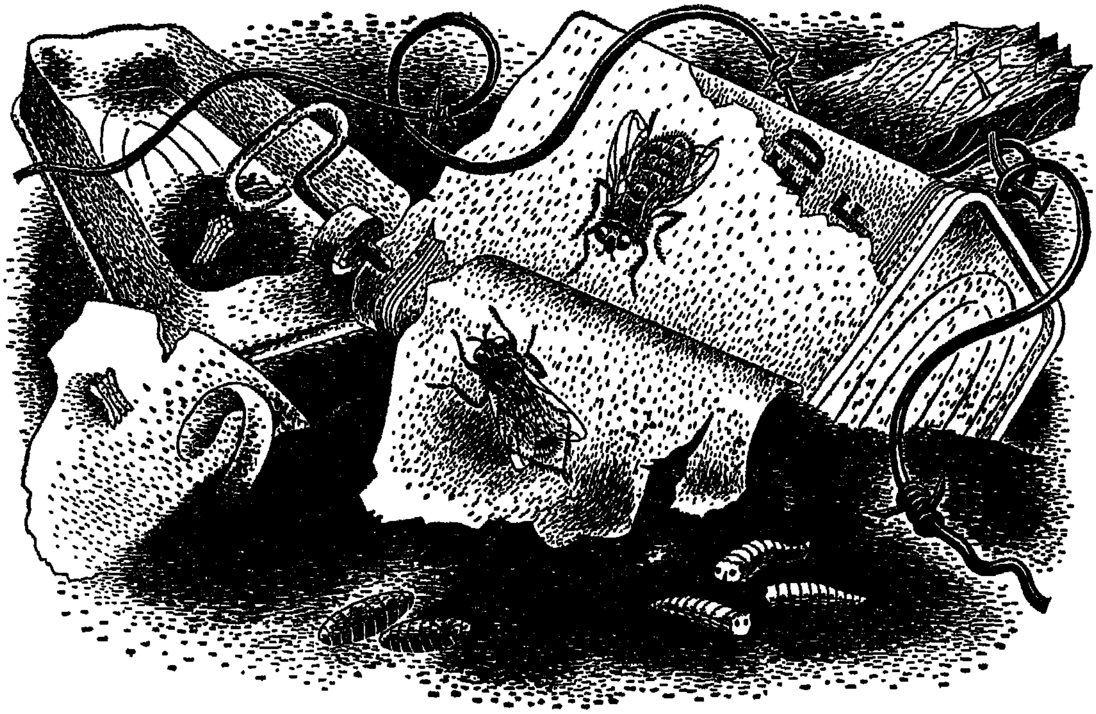
If you watch a fly as it crawls up the window you will see that it has six legs—three on each side. This is true of all insects; they not only have six legs, but their bodies are made in three parts—a head, which carries the eyes and feelers; a middle with legs and wings, and a hind part (or abdomen).

Some people think that any animal which crawls about and has a lot of legs is an insect. Think of woodlice, for instance. If you turn over a large stone or a log of wood you will often see the little grey or brown woodlice scurrying away and here and there one curled up in a ball. You will see that they are not insects, because they have more than six legs and their bodies are not divided into three main parts. Though they are land animals, they are related to crabs, lobsters, and shrimps; they spend much of their time keeping moist in the damp places in which they live. Spiders, too, though they are related to them, are not insects, as you can tell if you look carefully at a spider as she spins her web, for you can see her eight legs working.

Although insects are never large, what they lack in size they make up for in numbers. When you watch honey-bees going in and out of their hive it seems hard to believe there may be as many as sixty thousand of these little animals inside, and other insects are even more numerous. As for the different kinds of insect, nobody really knows just how many there are, but it is known that something over one million different kinds are in existence.

Some people are afraid of insects and believe the queer tales that are told about them. Perhaps you have heard the one about earwigs. It is said that at night they go into your ears and damage them. The truth is that if an earwig had the misfortune to fall into your ear the first thing it would do would be to hurry out again. It hates the smell of the wax in our ears, and this smell is disliked by other insects as well.

Although most insects are not harmful, some do carry diseases. House-flies

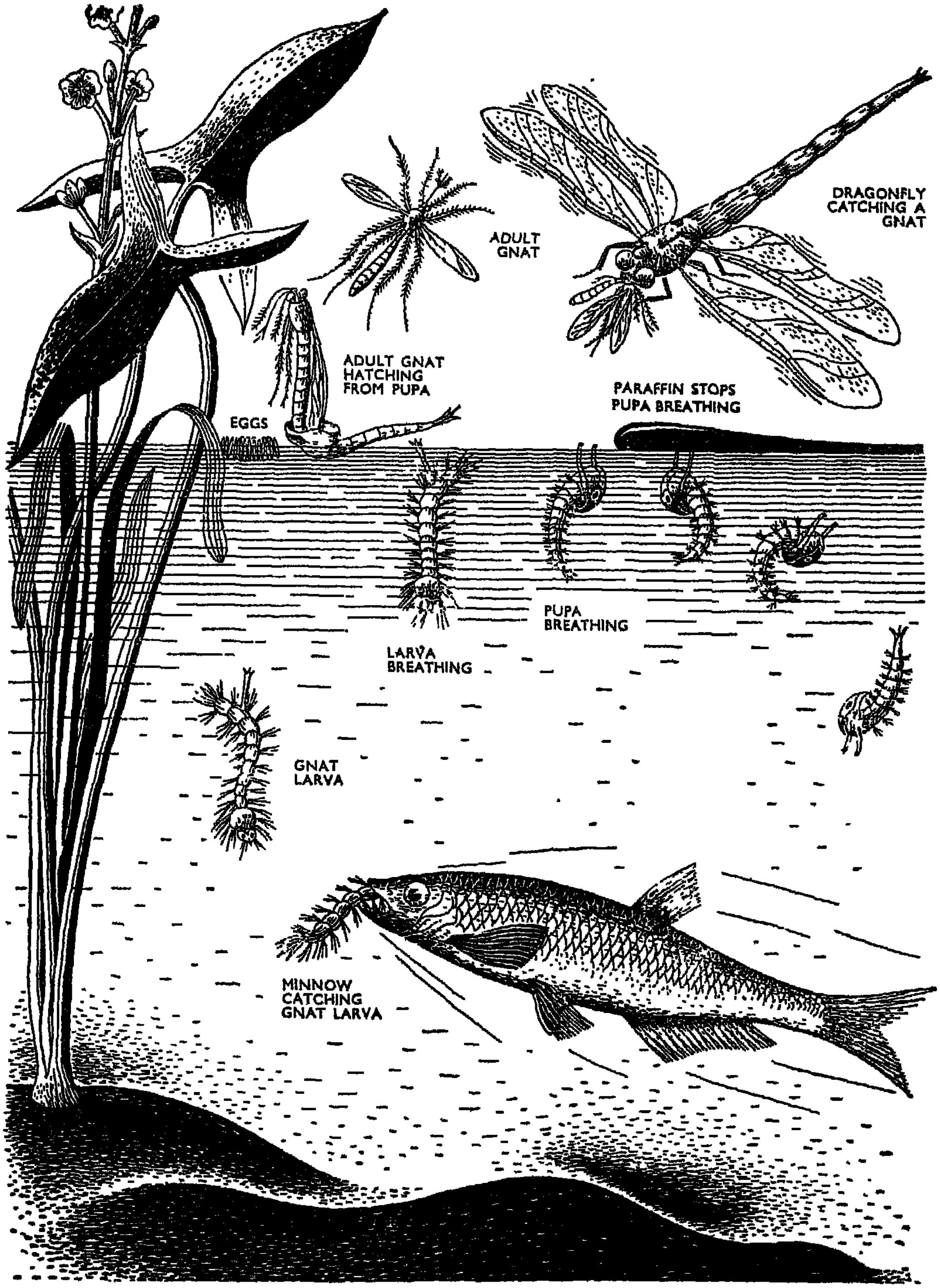


Flies carry disease from the filth in which they breed to the food on our tables. Here you can see how they lay their eggs on neglected rubbish and how the grub changes first into a pupa and then into a fly. To avoid spreading disease all rubbish should be burned or buried so that it does not attract flies.

are probably the worst offenders. They feed on all manner of rubbish and filth, and just as readily come to our tables and share our meals with us. Their sticky feet pick up germs and spread them to our food as they walk over it. One curious thing about them is that they cannot eat solid food. So they stick out their long, hollow tongues and dribble saliva on to what they want to eat, then they suck up the saliva and with it the food it has dissolved.

The female flies lay their eggs on damp rubbish; scientists have found that one of their favourite places is in the tea-leaves which people throw away. Over a hundred tiny white eggs are laid at a time, and in a few days they hatch out into little white maggots (or grubs). These maggots squirm about, feeding on the rubbish and growing until they are about a week old. Then each one shrivels and turns into a reddish-brown, barrel-shaped object, called a pupa. The pupa has a tough skin, and when, by the end of a couple of weeks, the house-fly has formed inside, it bursts its way out and joins the thousands of others which are such a nuisance to us on a hot day.

You have probably noticed that some of the house-flies to be seen indoors are larger than others. The smaller ones are not the young of the larger ones; they are just a different kind of house-fly, and


DRAGONFLY CATCHING A GNAT
ADULT GNAT
ADULT GNAT HATCHING FROM PUPA
EGGS
PARAFFIN STOPS PUPA BREATHING
PUPA BREATHING
LARVA BREATHING
GNAT LARVA
MINNOW CATCHING GNAT LARVA

Gnats lay their eggs in water, where they float. The larvæ and pupæ which swim about have to come up to the surface to breathe. Many are eaten by minnows and other fish and they can be killed by pouring paraffin on the water to prevent the larvæ and pupæ from breathing. When gnats have hatched out, many of them are eaten by dragon-flies.

never grow any bigger. Like many other insects, flies do all their growing while they are grubs. Some of the insect grubs are known by special names. For example, those of the blue-bottle are called gentles (which anglers sometimes use for bait); the grubs of butterflies and moths are called caterpillars, and the weevil is the grub of a beetle.

Most insects lay eggs which hatch into grubs which turn into pupæ, and when the pupæ hatch, out come the adult insects. Nearly all these adults have four wings, but you can always tell if an insect is a fly because all flies have one thing in common—they have only two wings.

WHY GNAT-BITES ITCH

The gnat is another fly which worries us. When you lie in bed on calm summer nights and hear the shrill whine which the female gnat makes as she flies in at the window, you know that she is after a meal. Gnats, like other flies, cannot feed on solid food. The male gnat is quite harmless and sips the sweet liquid inside flowers, which is called nectar, but the female gnat drinks a little of our blood. She pierces our skin with her sharp, hollow tongue, and so that the blood will not clot she squirts a little liquid down her tongue. Then she sucks up the blood and flies off sleepily to digest it. A gnat-bite itches because of the liquid the gnat has pumped into it.

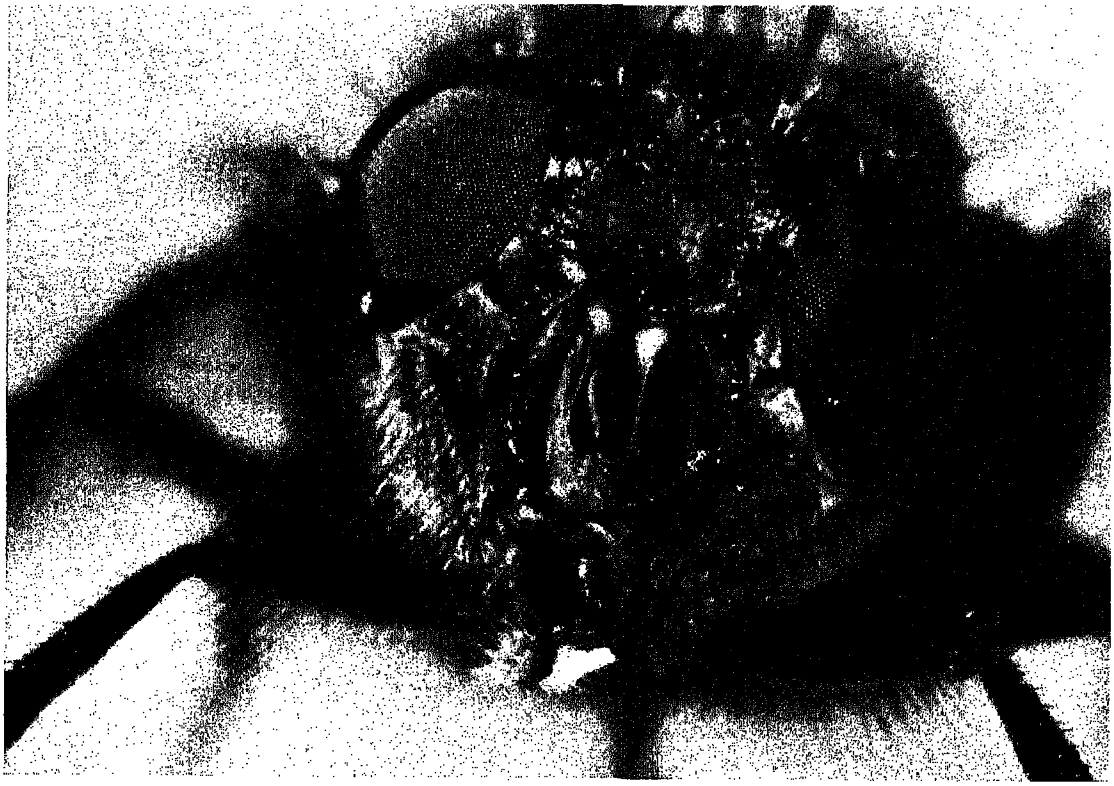
The easiest way to destroy gnats is to prevent them growing up. Gnats lay their eggs in water-butts, ponds, and ditches—wherever stagnant water is to be found. The eggs are laid in batches which float on the water like little rafts. When the grubs hatch out of the eggs they swim about in the water. These little wrigglers have to breathe, and so must come at intervals to the surface. Fish eat many of them, and after the pupæ hatch and the gnats come out of the water dragon-flies eat up a lot more of them. These natural enemies cannot do more than limit the numbers of gnats, and a much quicker way of destroying them is to pour paraffin on to the water. The oil prevents the grubs and pupæ from breathing.

Some insects make things difficult for farmers and gardeners by attacking the crops. Have you noticed how apple-tree leaves—and rose and plum leaves, too—sometimes curl and crinkle, especially near the tips of the stems? If you look under these leaves and on the tender young stems you will find masses of greenfly. Though they are small, there are so many of these little wingless insects sucking at the sap of the tree that they cripple its growth.

HOW ANTS MILK GREENFLY

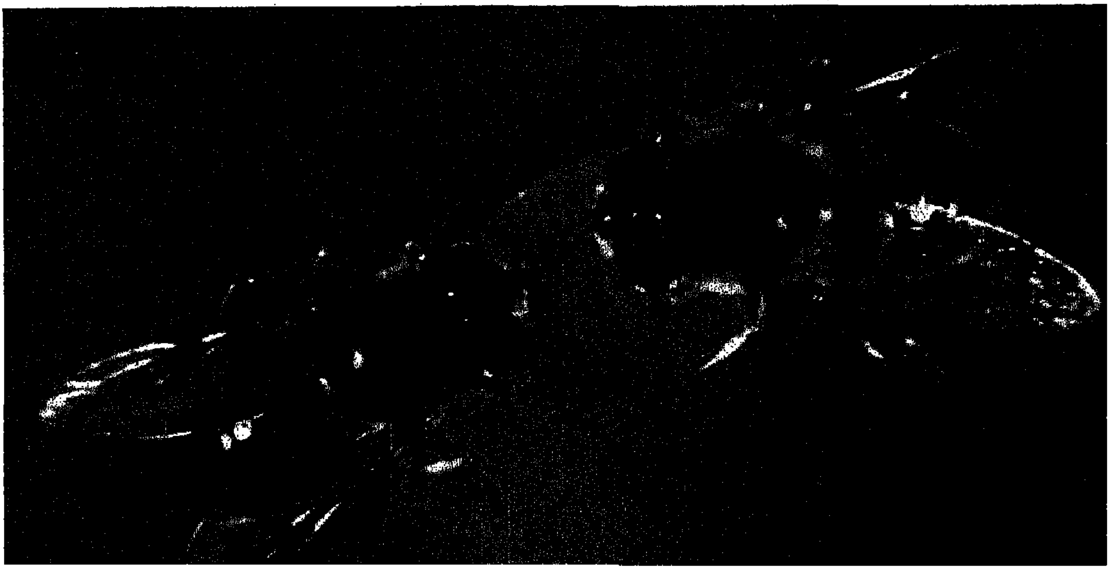
Tits eat many of these insects, but, since each living greenfly produces two more every day, the attacks of the birds on the greenfly, like those of the fish on gnats, cannot do more than limit their number. So we have to join in the fight against them, usually by spraying the trees or plants with a substance which poisons the greenfly. When greenfly have nearly crippled the plant-stem on which they are feeding, greenfly with wings are produced which can fly to a new stem and so do more damage.

In the autumn, instead of producing



DRONE-FLIES

There are over five thousand different kinds of fly in Britain, of which few are harmful. Those shown below *are drone-flies, which are so called because they look like honey-bees. They are drinking from a drop of syrup which has been put on a window-pane, and are able to hold on to the smooth upright glass because, like many other insects, they have sticky pads on their feet. The two large patches on the sides of the fly's head* (above) *are its eyes. Each eye is made up of about four thousand smaller eyes, each of which shows as a tiny white spot. In spite of this large number of eyes a fly's eyesight is not very good. They cannot see colours in the same way as human beings can, though they can see ultra-violet light in a way that we are not able to do.*

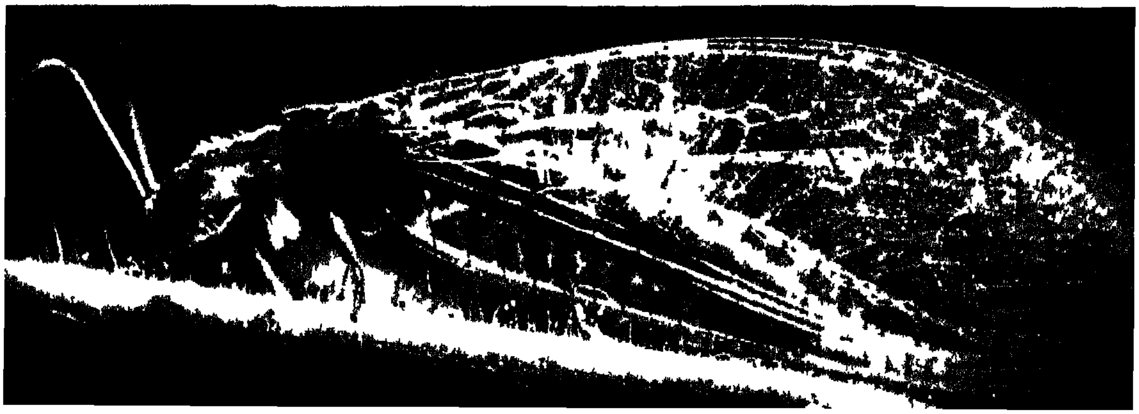


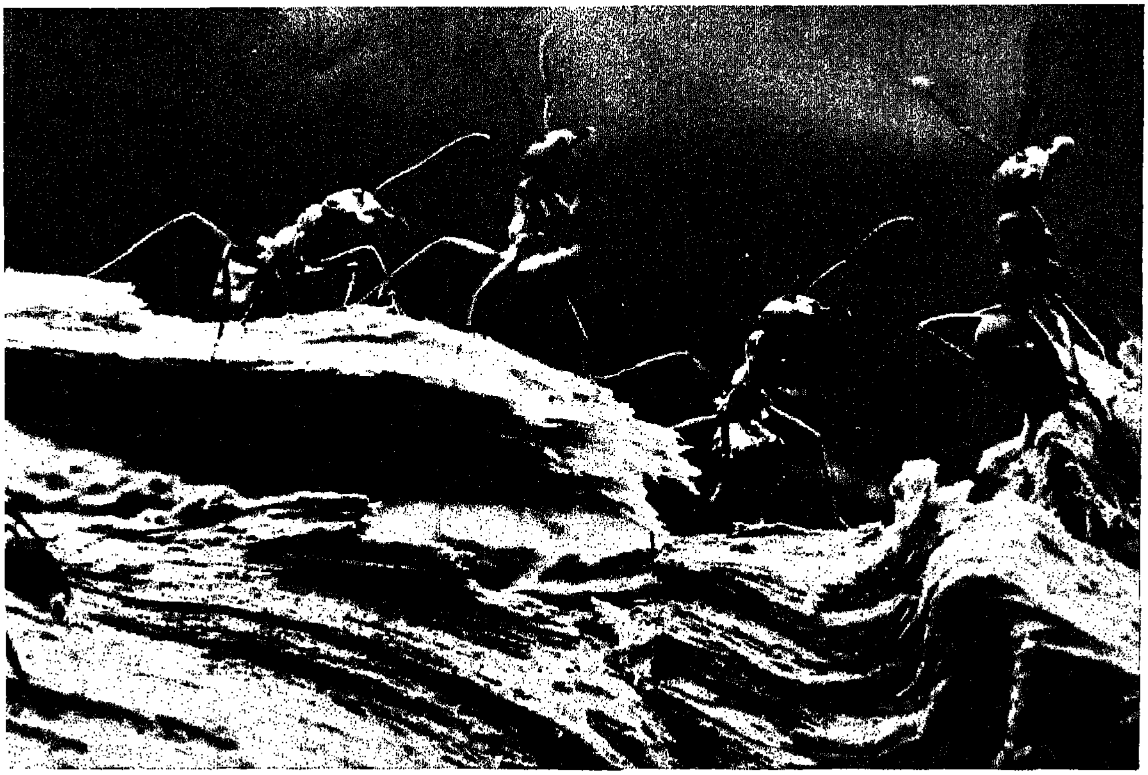
SOME COMMON BRITISH BEETLES

Although beetles differ considerably in size and the way they live, instead of front wings they all have stiff horny wing cases that protect the more delicate hind wings The long-horned beetle, shown top left, *is so called because its feelers are long compared with its body The grubs feed on different kinds of timber, some live in living trees, others prefer dead and decaying logs The adults feed on pollen and nectar and are small enough to find protection in flowers Another long-horned beetle, the musk-beetle,* bottom right, *is nearly one and a half inches long The grub lives in the stems of willow and the adult gives off the pleasant smell from which it gets its name The bloody-nosed beetle shown* top right *is so called because, if picked up, it gives out a few drops of blood from its front end as a means of defence The grub of this beetle eats leaves and stems of plants instead of wood Sometimes confused with the Colorado beetle is the may-bug, shown* bottom left. *This beetle comes out in May and June and lays its eggs in the soil The grubs, which may grow for as long as five years, are very greedy feeders and do great damage to the roots of plants, they may even attack tree seedlings*

SOME INSECTS CALLED FLIES

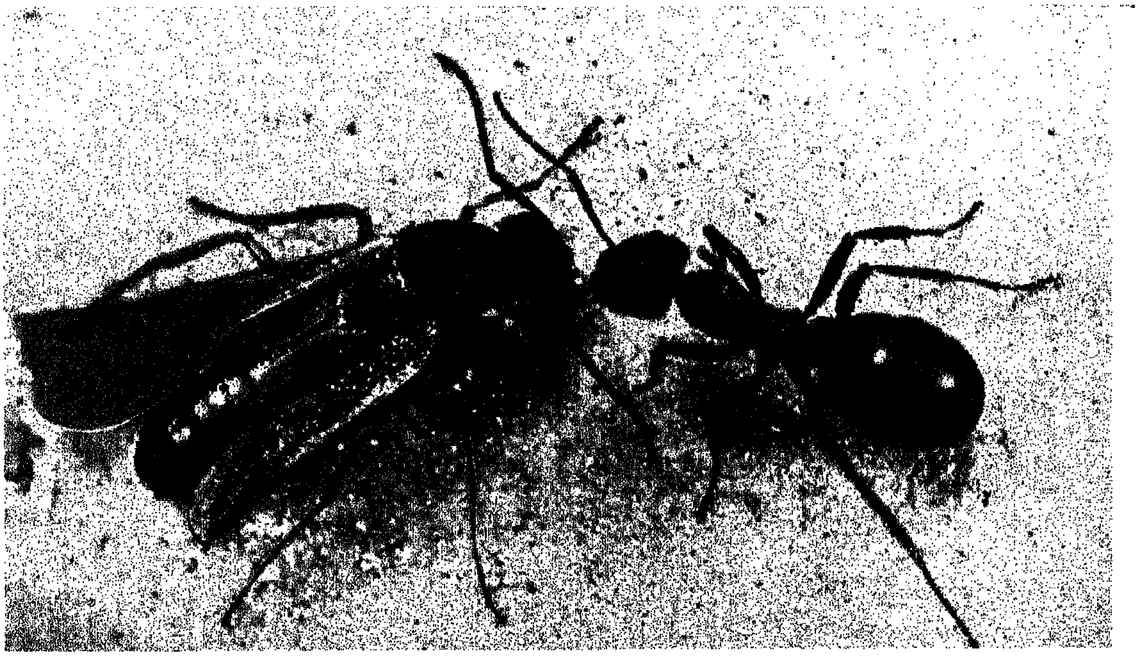
ough all the insects on this page are commonly called flies, only the horsefly (top right) *is truly so*
e female horsefly is found near water, where it lays its eggs on the waterside plants The male fly
es on dew and the nectar of flowers The sawfly, shown above left, *is not a fly but a close relative*
bees and wasps. Hawthorn sawflies lay their eggs in hawthorn hedges, and the green grubs which
tch from them feed on the leaves When fully grown the sawfly spins a cocoon in which it stays
ough the winter In the photograph the sawfly has just emerged from the cocoon Below the horsefly
shown an ichneumon fly, which like the sawfly is related to bees and wasps. It lays its eggs in the
ly of a butterfly caterpillar, and the grub feeds on the caterpillar until it is big enough to spin the
oon in which it changes to an adult ichneumon. The lacewing fly, shown below, *lays her eggs on*
leaves and stems and the grubs eat great quantities of greenfly.





LONG-LIVING INSECTS

Ants live in colonies in the ground. Most of them are wingless female ants called workers. In summer the colony produces winged females, known as queens, and winged males, or drones. These fly off in large swarms to found new colonies. After queen and drone have mated the drone dies, and the queen either finds a hole in the ground in which to start her own colony or may sometimes return to the nest from which she came. Both before and after mating, queens depend entirely on the workers for food. In the photograph below *a queen is being fed by a worker* (right). *Some ants have hollow needle-like stings with which they inject poison into their foes. Those shown in the photograph* above *have no stings; instead they have special glands in their hind ends with which they can squirt acid at their enemies.*



more greenfly, the insects lay eggs; these eggs lodge all the winter in crevices in the bark of trees. Sometimes greenfly are taken by ants into their nests for the winter, and in the spring the ants plant them among the branches of the trees. They do this because they like the sweet liquid which the greenfly produce, and they stroke the greenfly to encourage them to produce it. Sometimes they produce so much—especially from lime-trees—that it drips off the branches, making the ground wet and sticky.

You may have noticed how radish and cabbage seedlings in your garden sometimes mysteriously disappear just after they have come up. If you watch a bed of radish seedlings on a hot day you will see the small, shiny-black hopping beetles which are the cause of the trouble. As you look at one of these flea-beetles making tiny round holes in the seedlings—it suddenly disappears! It has given a mighty leap and has hopped on to another seedling several inches away.

TROUBLESOME LITTLE BOUNDERS

Flea-beetles are troublesome little bounders: they do enormous damage in fields of kale, turnips, and swedes. But they do not like damp, so you can save your seedlings by watering them; or you can do as the farmer does, and poison the beetles with derris powder or D.D.T. As soon as the plants get past the seedling stage they become too tough for the flea-beetles to hurt them, but at this stage kale and other greenstuff may be attacked by cabbage-white butterflies.

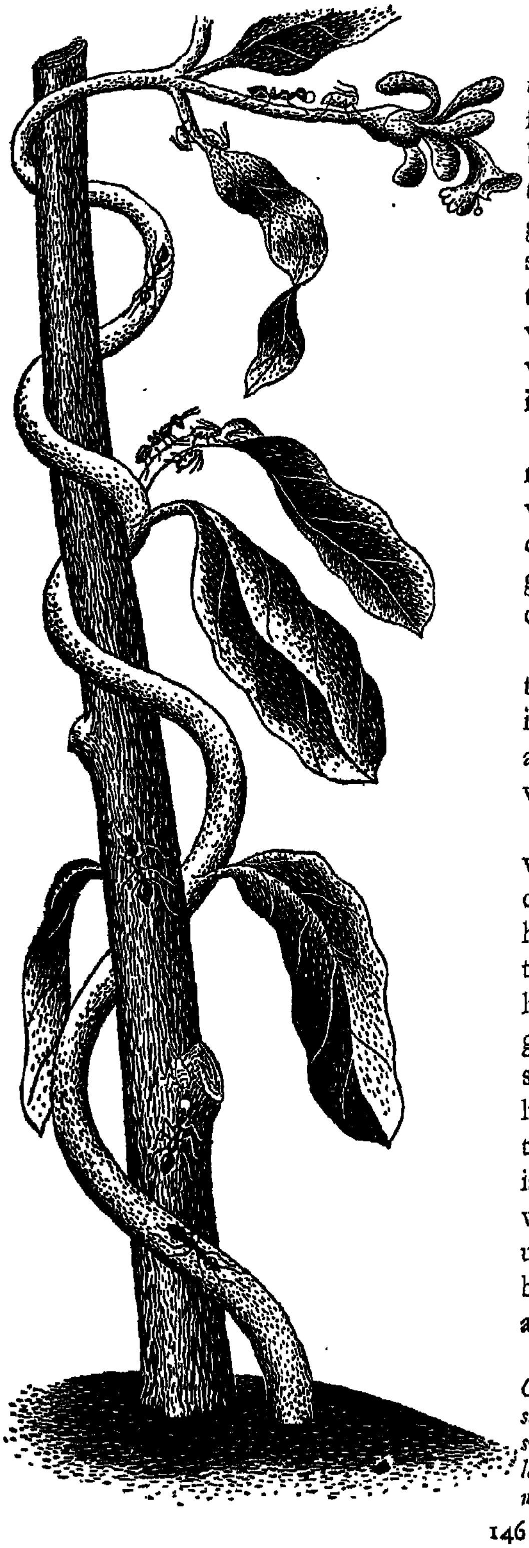
Sometimes in August and September you see whole beds of kale, cabbages and brussels sprouts looking like rows of ghostly skeletons. The leaves have been eaten, only the stems and the veins of the leaves remaining. It is not the cabbage-white butterflies themselves, but their grubs, the caterpillars, that cause the damage.

HOW MOTHS SPOIL APPLES

Some insects attack our crops from within, and no one enjoys a mouthful of apple when he finds that a caterpillar inside it has had the first bite! When we find these caterpillars in apples we call them maggots, and you probably wonder where they have come from and how they got into the fruit. To find out we must follow the maggot to see where it goes after it has eaten its fill of apple.

As soon as the maggoty apple falls from its branch the caterpillar comes out and crawls towards the trunk of the tree. It climbs into a crevice in the bark, and here it spins a silken case, inside which it settles down for the winter. In the spring out comes a most beautiful moth, and to look at it you would not believe that it could do so much harm. For this handsome moth has greyish-brown wings which have on them bands of a deeper rich brown, and on the tips of the front wings a rich, shining, copper-coloured splash. But, lovely though it is, this is the codling moth—the apple-grower's dreaded enemy, and he wages a bitter war against it.

Soon after the moths have hatched in the spring they go flitting among the leaves and blossoms of the apple trees, where they lay their tiny eggs either in



the open blossom or on the young fruits. The small grubs, or caterpillars, hatch out, and bore their way through the eye of the fruit into the core of the growing apples. As the fruit grows and swells the codling caterpillars feed on the pips and flesh, and you can often tell which of these apples have caterpillars within, for in the eye of a maggoty fruit is a hole filled with a brown, dusty mess.

The damage that the caterpillar does not only spoils the apple, but also weakens its hold on the tree, so that during the gusty weather it falls to the ground before it is ripe. That is why you often find maggots in windfall apples.

Very soon after the apple has fallen the grub inside it is full-grown. It bores its way out through the side of the apple and crawls to the trunk of the tree, where it spends the winter.

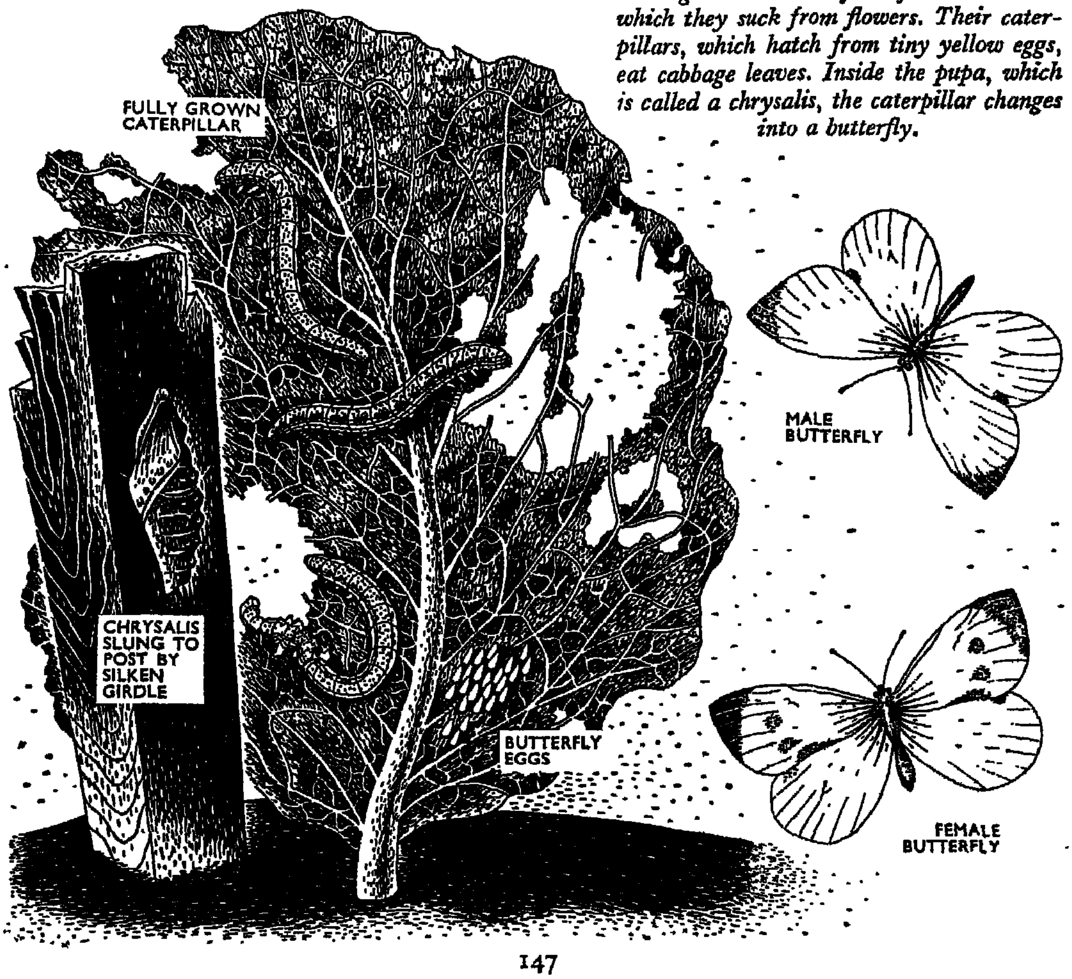
The codling moths themselves are very hard to catch, and the fruit-grower does not often try to kill them. Instead, he attacks the caterpillars, first while they are very young, and if any escape he attacks again when they are full-grown. The first attack takes place as soon as the small caterpillars have hatched from their eggs and are making their way into the young apples. Then it is that men go into the apple orchards with powerful pumps and spray poison up into the trees. Some of this reaches the blossoms and kills the caterpillars, but it also kills other insects as well. This is a

Greenfly are often to be found on some plants. They suck the sugary sap of the plants and give off a sweet liquid known as honeydew which is greatly liked by ants. To encourage the greenfly to give off more honeydew, ants stroke them with their feelers.

pity, since some of these insects are friends. This poison does not hurt us when we eat the apples, as by that time the weather has washed the poison away.

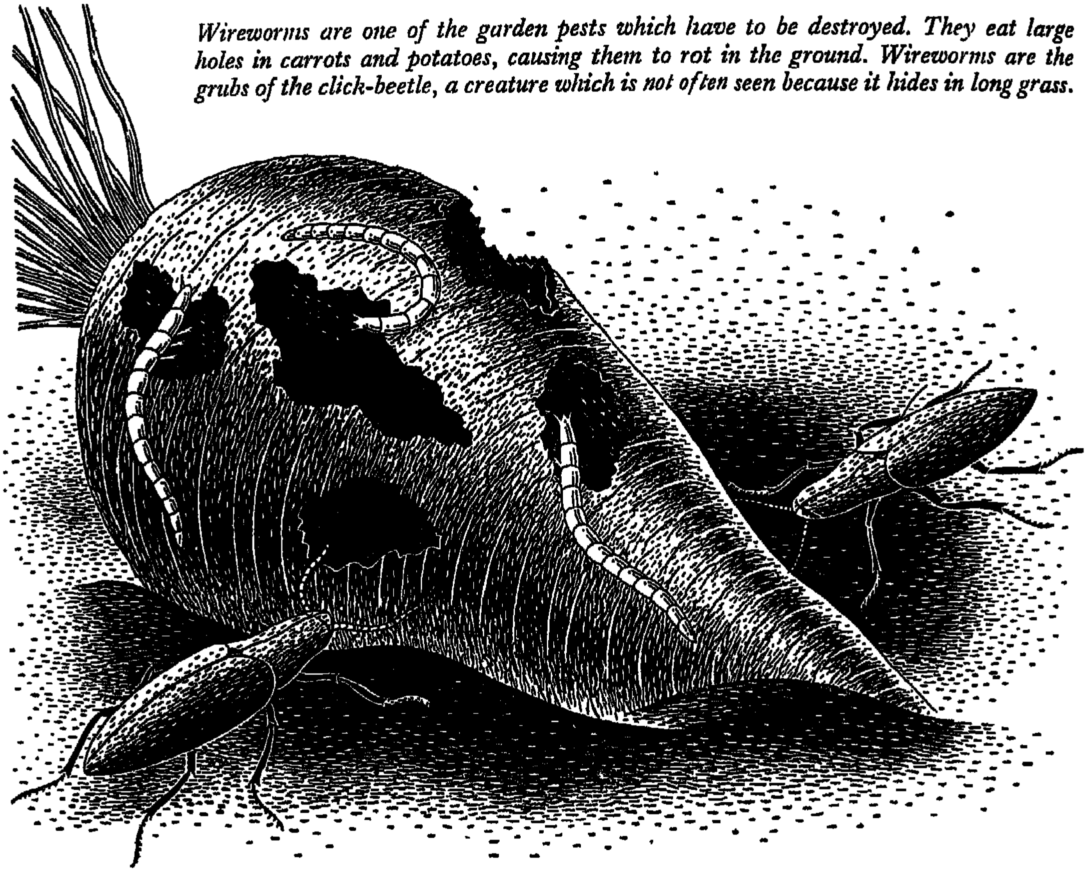
But if there are still many caterpillars left alive you can do no more until they crawl out from the windfalls. Then, if you tie sacking round the trunks of your trees and crumple it about, the caterpillars will nestle in it, and when they are all comfortably settled in its folds you can take off the sacking and burn it.

Insects which attack the roots of our crops are more difficult to destroy. Sometimes when you are digging you come across little yellow, sleepy-looking grubs in the ground, which are called wireworms, although some people mistake them for centipedes. They are not worms either, but are insects, as you can see from their six legs near the front. Wireworms are the grubs of the small, black, hard-shelled click-beetles which you do not often see, because they wander about in the long grass, laying their eggs in the ground. They are called click-beetles because if you turn them on their backs they flick their hard, shelly



Cabbage-white butterflies feed on nectar which they suck from flowers. Their caterpillars, which hatch from tiny yellow eggs, eat cabbage leaves. Inside the pupa, which is called a chrysalis, the caterpillar changes into a butterfly.

Wireworms are one of the garden pests which have to be destroyed. They eat large holes in carrots and potatoes, causing them to rot in the ground. Wireworms are the grubs of the click-beetle, a creature which is not often seen because it hides in long grass.

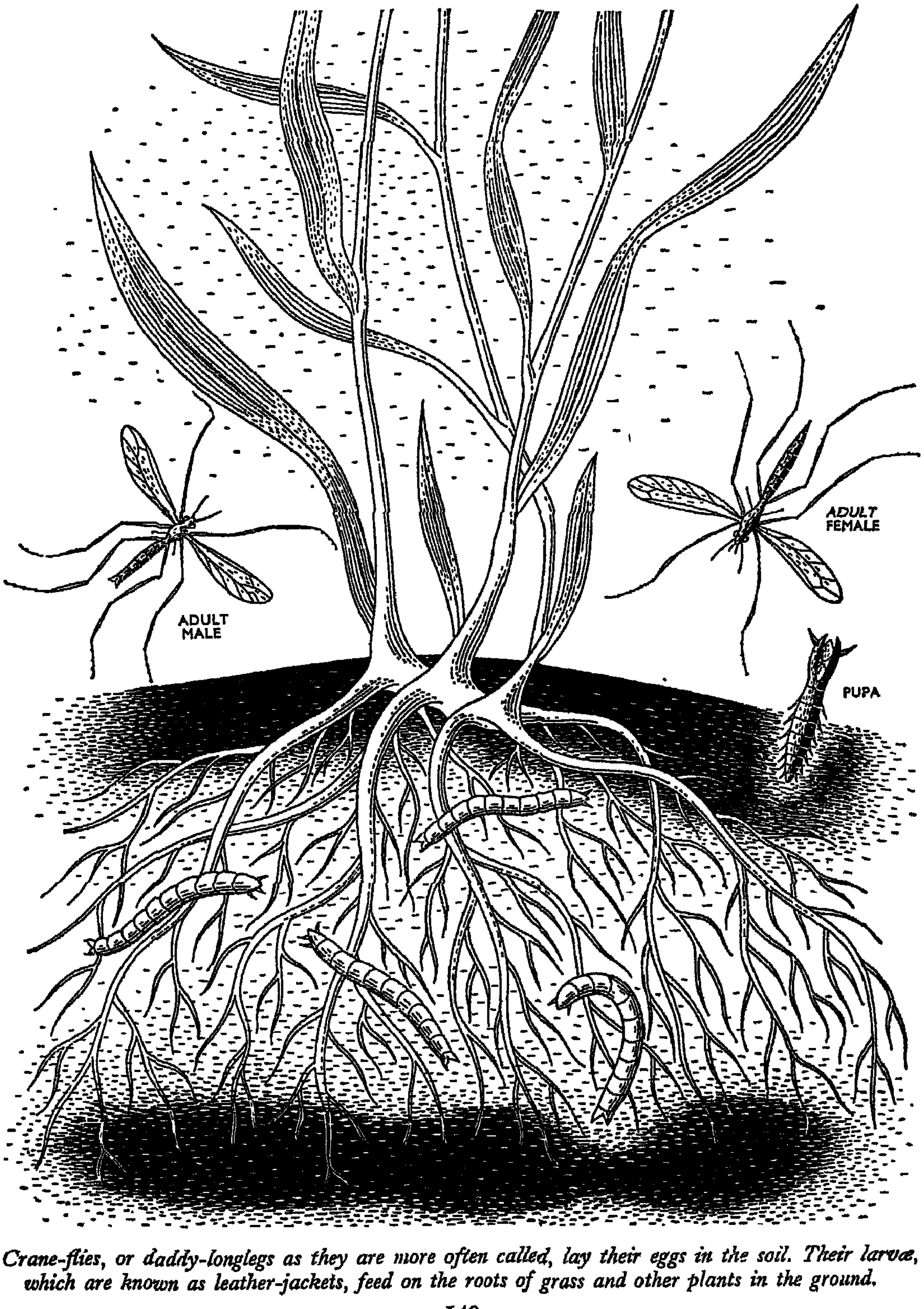


wing-cases against the ground with a click. Up in the air they go, and land the right way up on their feet.

Although the click-beetle's grubs, the wireworms, are small, it may take them as long as five years eating and growing before they become three-quarters of an inch long and ready to turn into pupæ. But the click-beetles that hatch from the pupæ live for only a year or two. Birds are fond of wireworms; sometimes a robin will hop down and pick them up under your very nose as you dig in the soil. Digging also helps birds to find leather-jackets, another soil-pest.

Leather-jackets are the grubs of the daddy-longlegs. It seems odd to talk about a female daddy-longlegs, but it is, of course, the female who lays the eggs in the soil. She lays hundreds of small black eggs, which hatch out into leather-jackets. When the leather-jackets are full-grown they look like short, greyish-green earthworms, and are not easy to spot. But birds have very good eyesight; lapwings, gulls, and rooks catch many of these little pests.

These birds, and starlings, too, also eat a great many of yet another root-eating pest of this kind. This is the grub of the cockchafer beetle. The fully grown beetle is about an inch long and is reddish-brown. These beetles are found in May or June, and are sometimes mis-



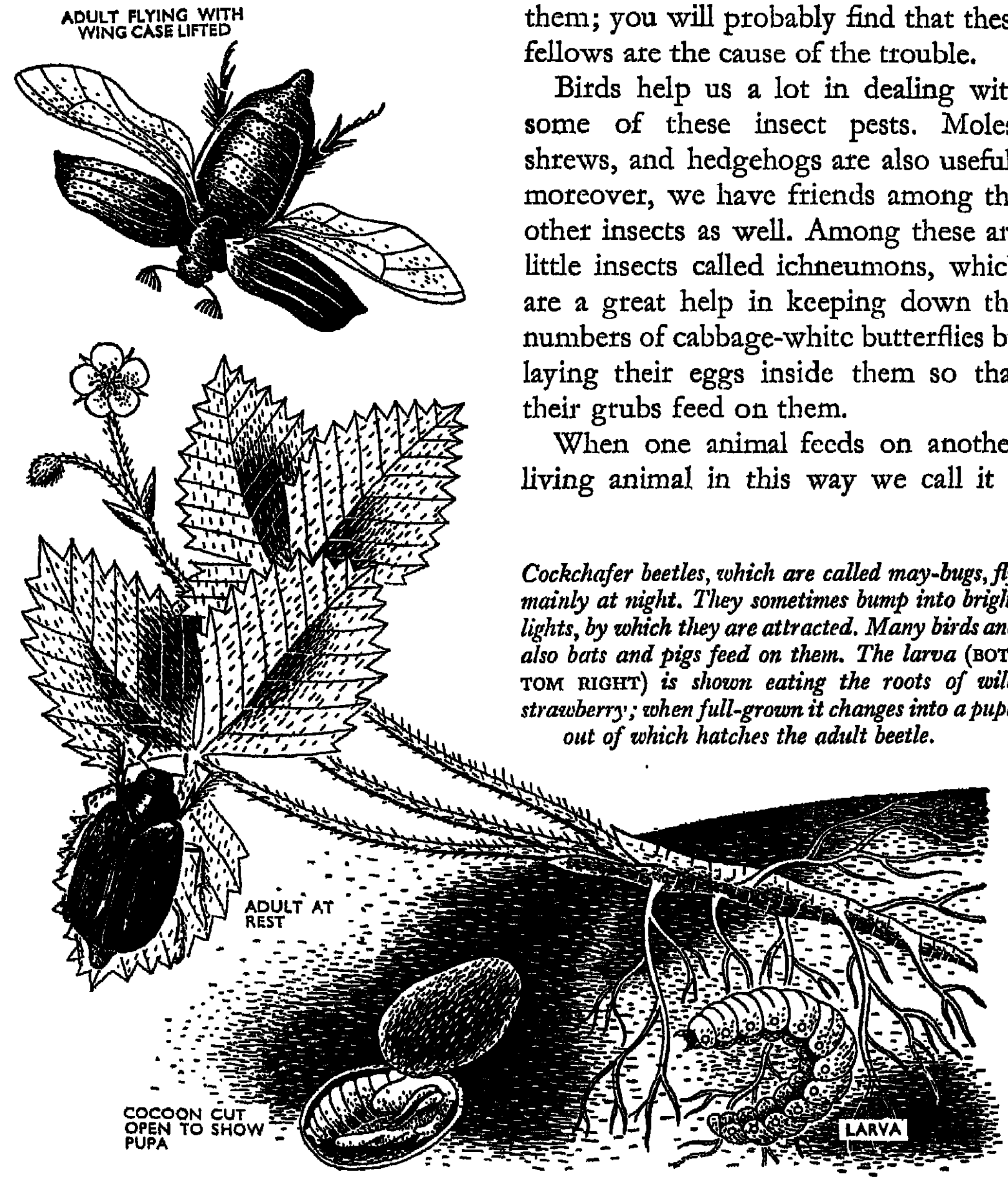
Crane-flies, or daddy-longlegs as they are more often called, lay their eggs in the soil. Their larvæ, which are known as leather-jackets, feed on the roots of grass and other plants in the ground.

taken for the Colorado beetle, which attacks potatoes often in foreign countries and sometimes in Britain. Cockchafer beetles are often dead when you find them. This is because they die soon after laying their eggs. The eggs hatch out in the soil, and the tiny white grubs feed underground on our crops.

For three years—or sometimes even four—the cockchafer grubs stay in the soil, growing into gruesome white things about an inch and a half long. They have brown heads and strong jaws, which they use for biting. If you find that your strawberry plants have wilted and died, poke about underneath them; you will probably find that these fellows are the cause of the trouble.

Birds help us a lot in dealing with some of these insect pests. Moles, shrews, and hedgehogs are also useful; moreover, we have friends among the other insects as well. Among these are little insects called ichneumons, which are a great help in keeping down the numbers of cabbage-white butterflies by laying their eggs inside them so that their grubs feed on them.

When one animal feeds on another living animal in this way we call it a

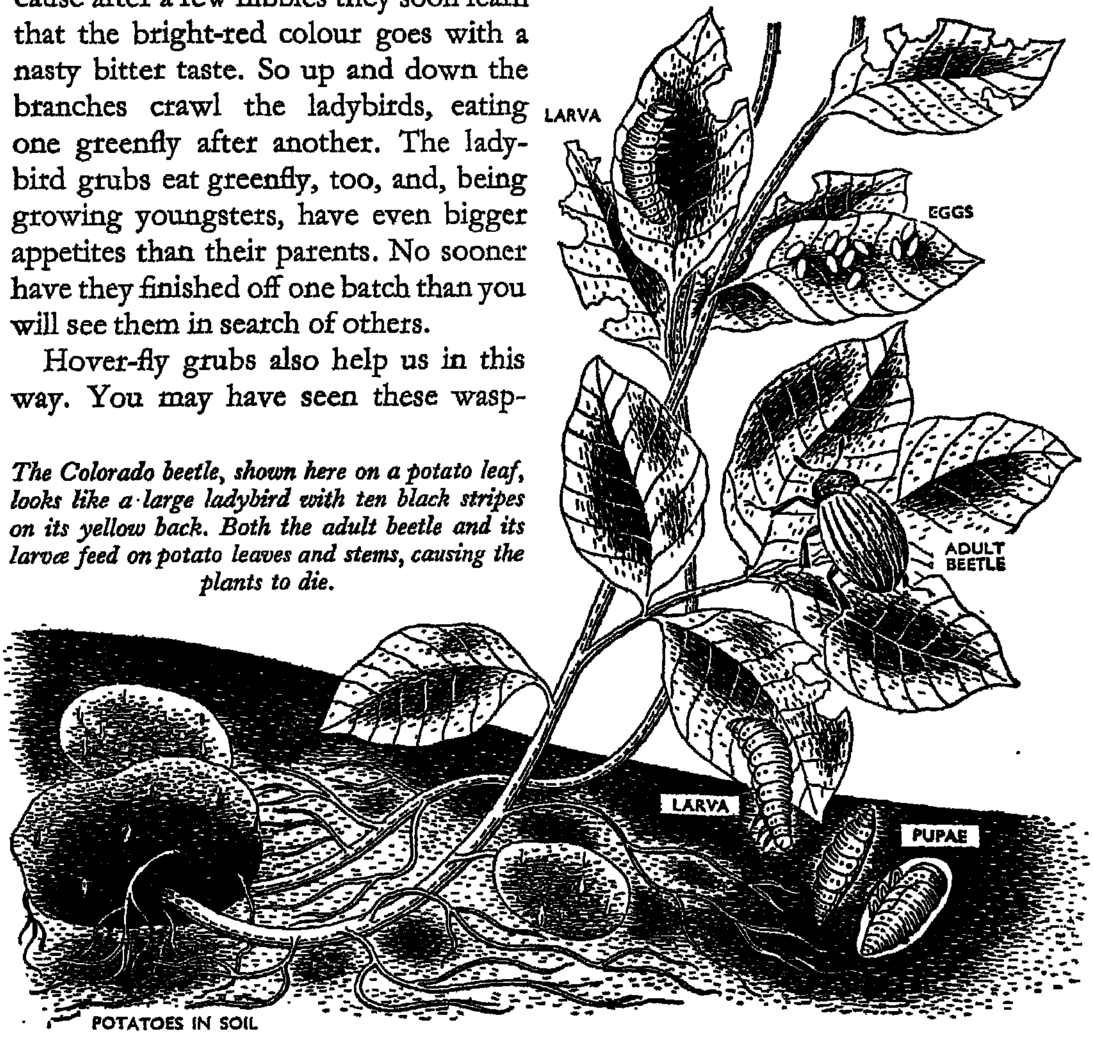

ADULT FLYING WITH WING CASE LIFTED
ADULT AT REST
COCOON CUT OPEN TO SHOW PUPA
LARVA

Cockchafer beetles, which are called may-bugs, fly mainly at night. They sometimes bump into bright lights, by which they are attracted. Many birds and also bats and pigs feed on them. The larva (BOTTOM RIGHT) *is shown eating the roots of wild strawberry; when full-grown it changes into a pupa out of which hatches the adult beetle.*

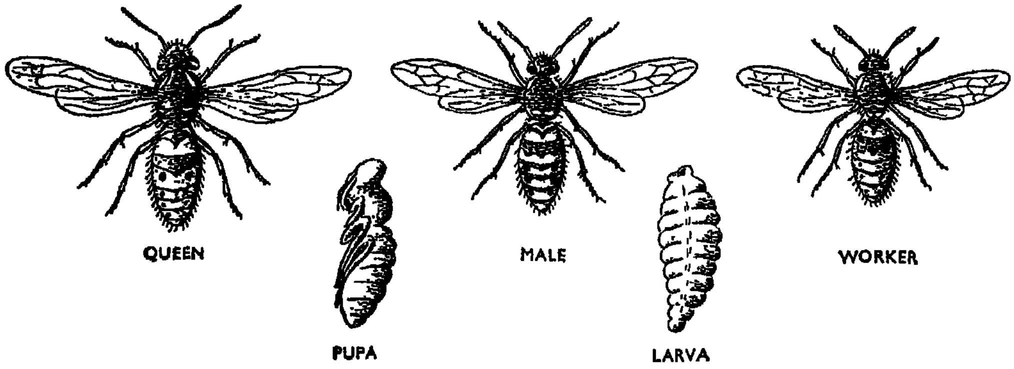
parasite. Other insect parasites also attack leather-jackets and codling moths in this way, and greenfly also have this kind of trick played on them.

To see our best allies in the war against greenfly we must go back to the rose tree. Creeping quietly about the stems and the leaves are the ladybirds that everyone knows. These little shiny-red beetles feed on the greenfly. Their bright colour makes them easy for birds to see, but birds seldom harm them, because after a few nibbles they soon learn that the bright-red colour goes with a nasty bitter taste. So up and down the branches crawl the ladybirds, eating one greenfly after another. The ladybird grubs eat greenfly, too, and, being growing youngsters, have even bigger appetites than their parents. No sooner have they finished off one batch than you will see them in search of others.

Hover-fly grubs also help us in this way. You may have seen these wasp-like flies, hovering motionless in the air, suddenly dart off, only to hover again. Their wings move so fast that all you can see of them is a blur on each side of the fly. Hover-flies cannot sting, but many animals leave them alone, probably because they mistake them for wasps, just as we do sometimes. The flies feed mostly on the pollen of flowers, but sometimes as you watch the female fly darting about you will see her going



The Colorado beetle, shown here on a potato leaf, looks like a large ladybird with ten black stripes on its yellow back. Both the adult beetle and its larvæ feed on potato leaves and stems, causing the plants to die.

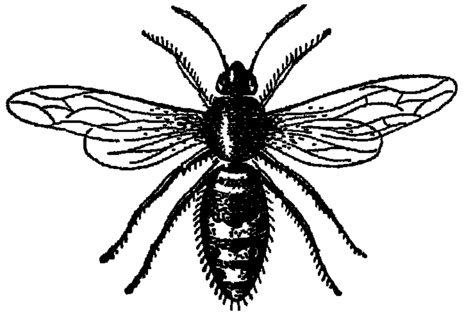


WASPS

from stem to stem as though trying to find one that suits her. She is looking for a place to lay her eggs. When she has found the right stem she lays a little cluster of yellow eggs on it.

The whitish grubs that hatch from these eggs crawl about looking for greenfly and other insects, and as they creep along you can see them stretching their bodies, rather in the same way as do earthworms. When the grub finds a greenfly it stabs it with its sharp curved jaws, and sucks the life out of it.

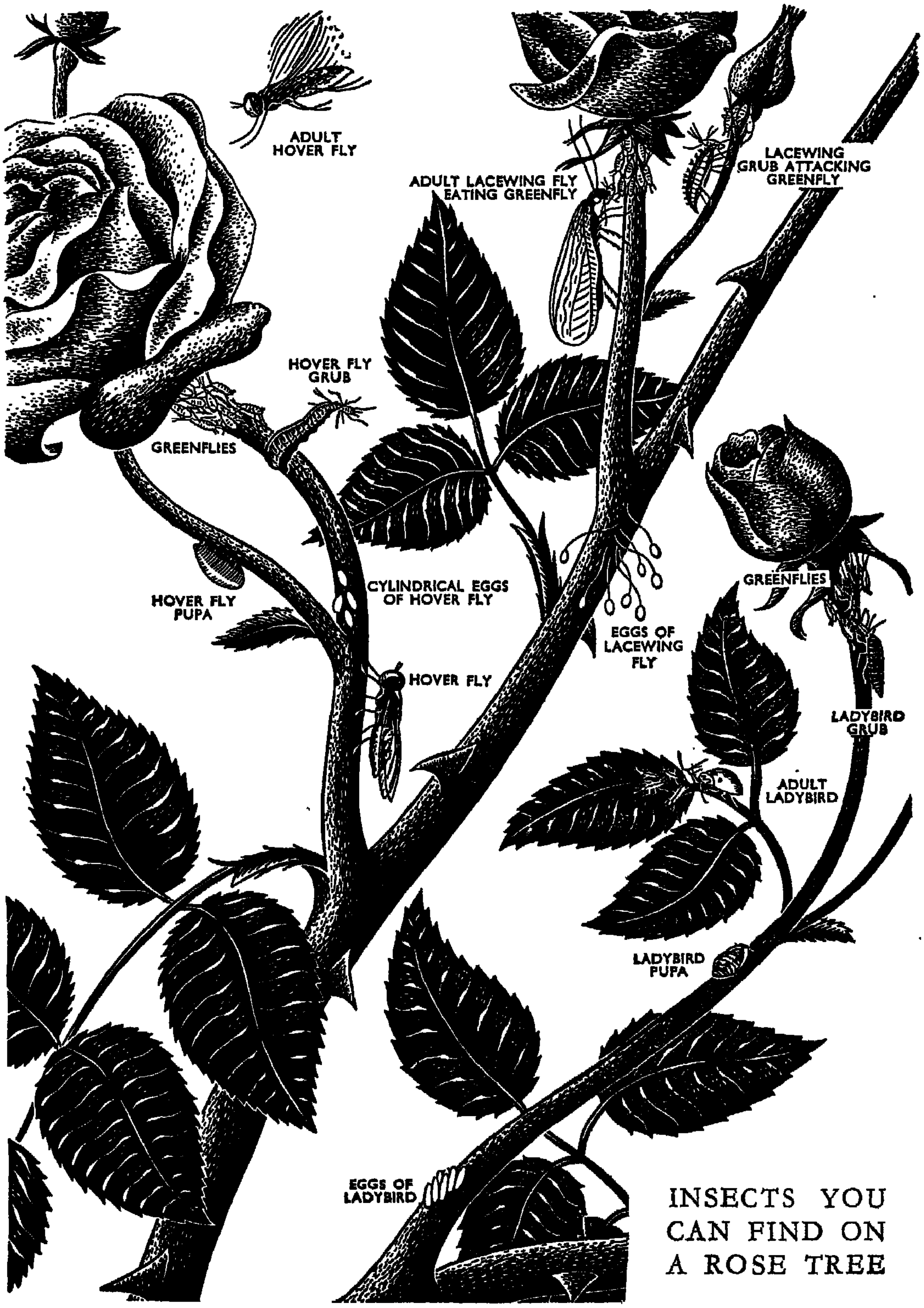
A much nicer-looking insect friend is the lace-wing fly. The female is a very refined lady, with beautiful gauzy-green wings, long, slender legs and, on her head, very long, delicate feelers. Everything about her is long, slender, and delicate—even her eggs have long stalks, and you can see them hanging in little clusters from the leaves. She has a rather dainty appetite, likes sweet things and occasionally takes a greenfly or two, but her grubs greedily catch greenfly after greenfly, sink their jaws into them and suck them dry. These youngsters are not nearly as daintily mannered as their mother, but they are much more useful.



Hornets differ from wasps (shown ABOVE*) in that they are larger and browner in colour.*

As all the insects so far mentioned go about their work they seem to pay little heed to their brothers and sisters. Even caterpillars that have hatched from the same batch of eggs will wander off as they get older and live their own lives. Insects that live by themselves in this way are called solitary insects. But some insects, like wasps, bees, and ants, live together in families or colonies and share out the work among themselves. When insects live together in this way we call them social insects.

One of the social insects is the wasp. Many people do not like wasps because



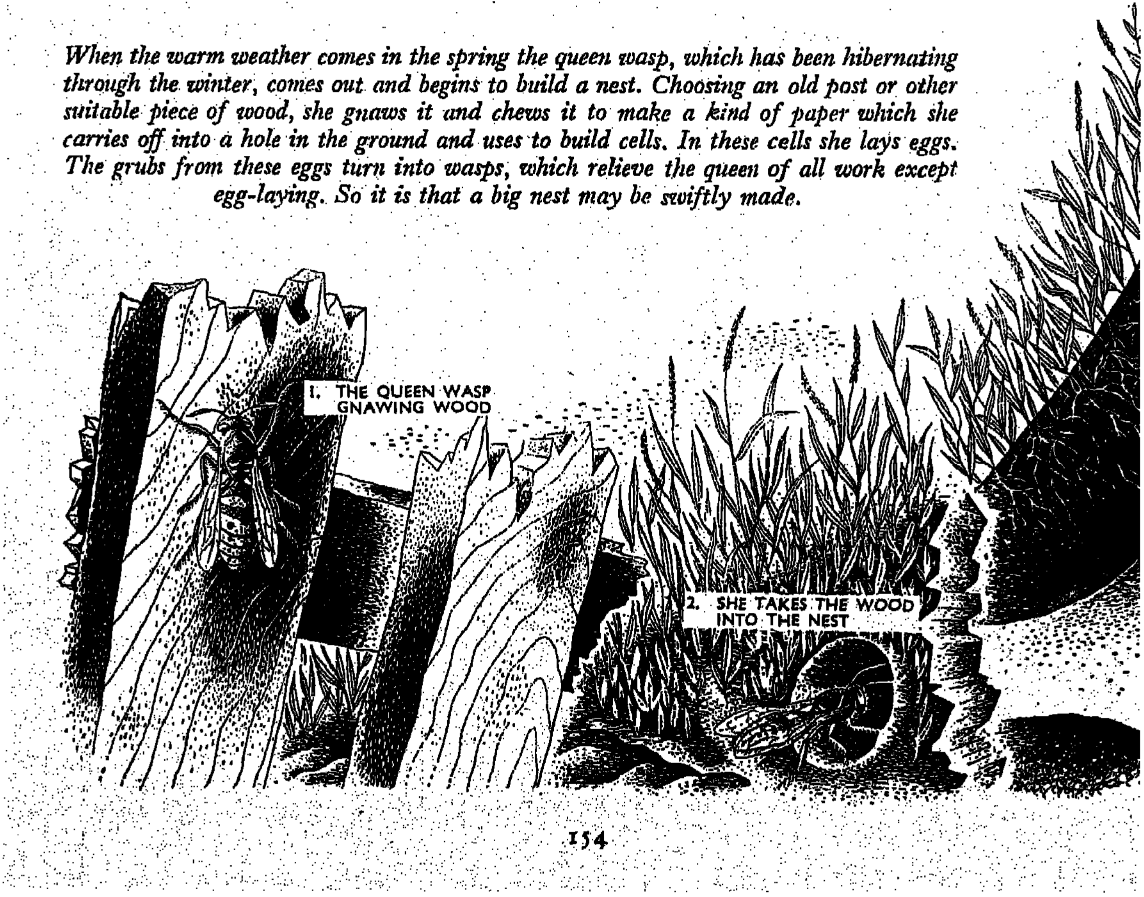
INSECTS YOU
CAN FIND ON
A ROSE TREE

they seem to like the same food as we do—especially if there is jam for tea! Although nobody likes a wasp-sting, we should be fair to the wasps—they sting us only when we interfere with them. We should really be grateful to wasps because of the large number of harmful caterpillars they kill.

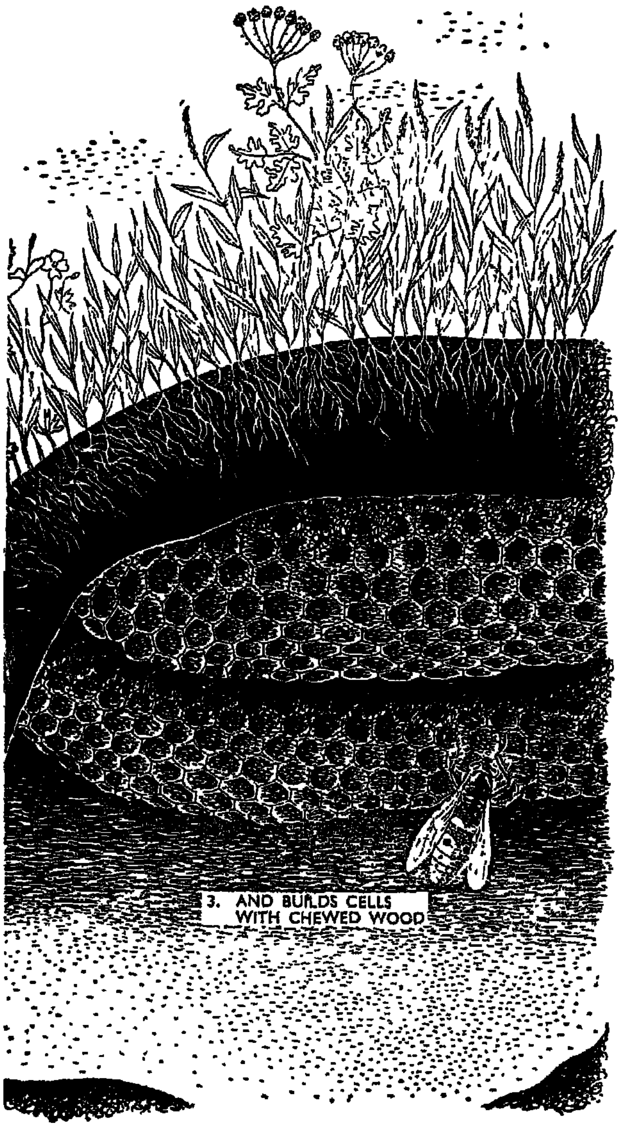
In the spring you may find a very large wasp indoors, flying about trying to get out. This is a queen (or mother) wasp that has been sleeping quietly all through the winter. Some people think she is a hornet, but hornets are larger and are darker in colour. If you could follow the queen wasp as she flies out of the window you would see her make for a hole in the ground—a disused mouse-hole in a field or under a tree, perhaps. She goes inside and hollows out a small "room" by carrying soil outside and dropping it some distance from the hole. Her next job is to build the nest, and she makes this out of wood. She has very strong jaws, and as you watch her at work biting little bits of wood from an old fence you can hear the noise made by her jaws as they tear at the splinters.

Inside the hole she chews the wood and makes it into a kind of paper. This she shapes into little cups called cells, which she sticks upside down on the roof of her cave. Her first eggs go into these cells, and when the grubs hatch she feeds them on caterpillars and other insects which she catches. Building the

When the warm weather comes in the spring the queen wasp, which has been hibernating through the winter, comes out and begins to build a nest. Choosing an old post or other suitable piece of wood, she gnaws it and chews it to make a kind of paper which she carries off into a hole in the ground and uses to build cells. In these cells she lays eggs. The grubs from these eggs turn into wasps, which relieve the queen of all work except egg-laying. So it is that a big nest may be swiftly made.


1. THE QUEEN WASP GNAWING WOOD
2. SHE TAKES THE WOOD INTO THE NEST

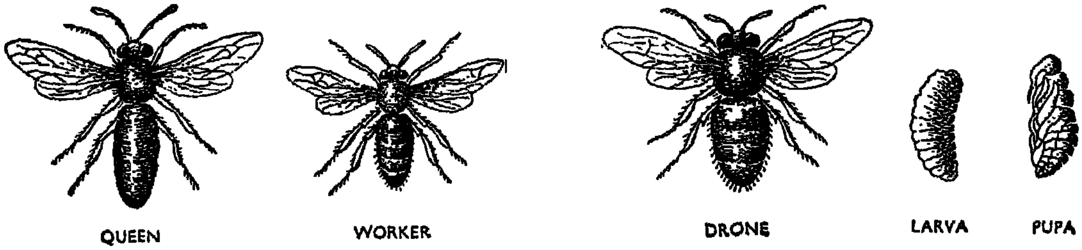
nest, laying the eggs, and feeding the grubs are hard work; but these grubs soon turn into pupæ, and when wasps have hatched from the pupæ the queen has some help. These wasps are her offspring, which we call workers, because from now on they take over most of the work of the home. They enlarge the hole, fetch more wood and make more cells. The queen now stays at home and lays eggs in these cells. The workers fly about, catching insects which they use to feed the grubs. Thus the family grows in numbers and the nest in size.


3. AND BUILDS CELLS WITH CHEWED WOOD

A wasps' nest in the summer may be as large as a football, and you sometimes see the remains of one when a farmer's plough shatters it and lifts it out of the ground. The layers of papery cells in the nest are surrounded by a case of streaky brown wasp paper; and all this paper has been made from wood which the wasps have carried into the nest. There may be as many as fifteen hundred wasps in a large nest, and in the summer some of these wasps are the males and they are known as drones. The mother queen also produces some daughter queens at this time, and after they have mated with the drones they go off in search of a place to spend the winter. This is why you find them in your house in the spring.

In the winter all the wasps left in the nest die, and this is what happens to humble-bees, too. These black-and-yellow woolly bees build their colonies in the same way as wasps, and only the queens live through the winter.

The bees which we keep in beehives —honey-bees—live with their queens right through the winter, feeding on the honey and pollen that they have saved up in the summer. Honey-bee workers are rather wasp-like to look at, but are smaller and dark brown. You sometimes see them on sunny winter days taking the fresh air outside their hives. But in



HONEY BEES

the cold weather they snuggle inside, keeping one another warm.

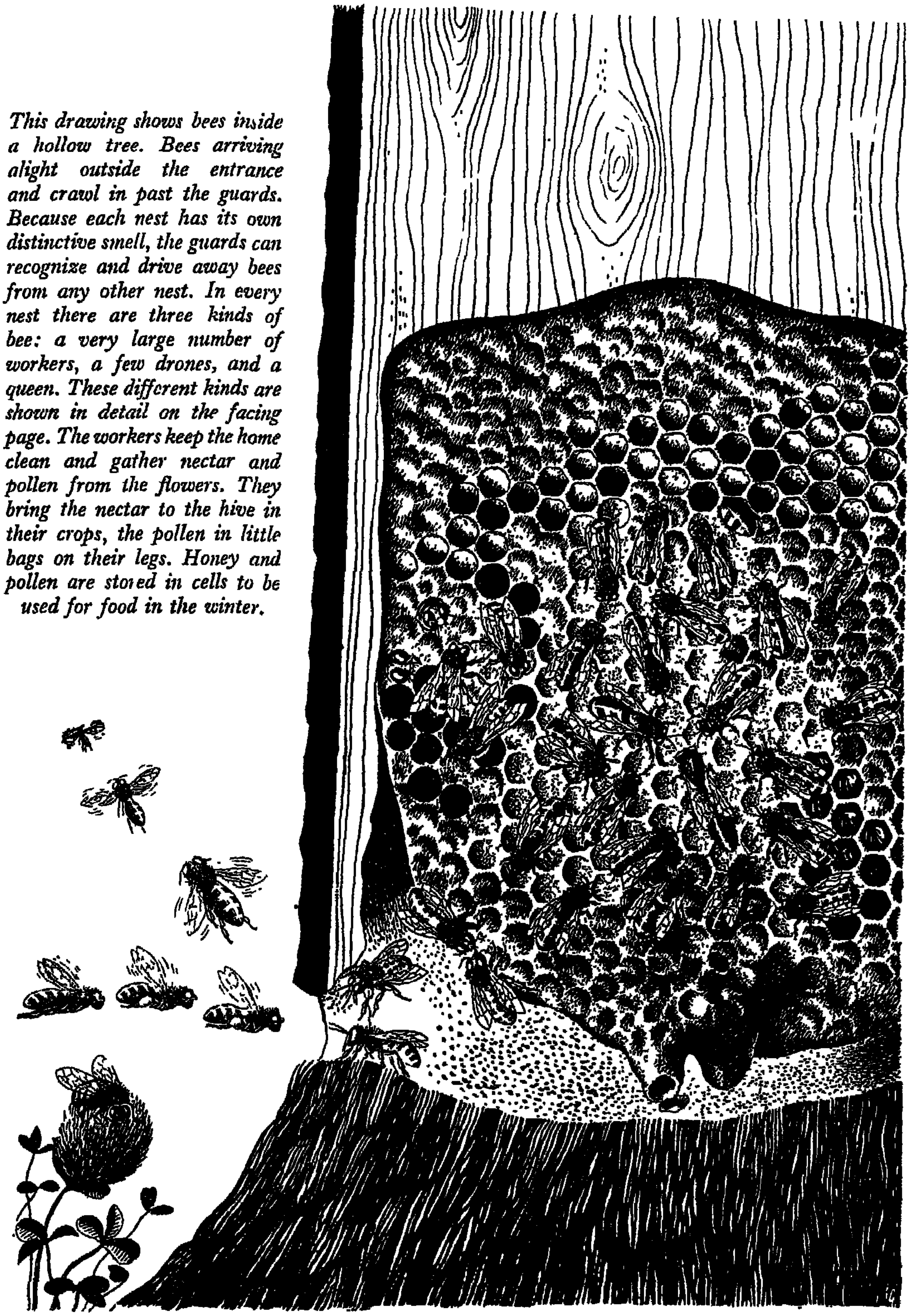
Honey-bees sometimes nest in hollow trees. They make their cells of beeswax, and the layers of cells hang upright in the tree. These layers of cells are called combs, and the bees store honey and pollen in the combs as well as feed their grubs in them.

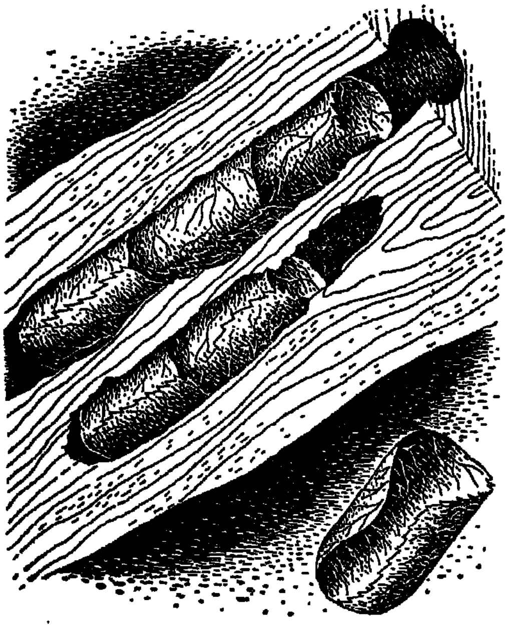
The queen is larger than the workers and depends on them to feed her while she wanders about on the combs laying eggs in the cells. She is very good at this, and, though she starts slowly in the early spring, by April or May she can lay three or four eggs a minute! Most of these eggs turn into workers, so it is no wonder the colony becomes crowded. But a few of the eggs grow inside special cells, called queen-cells, and become queens later on; others grow into male bees or drones, who also depend on the workers to feed them.

When the workers have built several of these queen-cells you know they are about to swarm. If you are near-by when it happens you will hear the roar of their wings as the old queen, with tens of thousands of workers, comes tumbling out. They surge upwards in a great cloud and whirl around in the sunshine. They are so full of the honey they have eaten that they hardly ever sting as they frolic in the air. After a few minutes you will notice that some of them are settling on the bough of a tree. In a little while the swarm has settled around them.

Somewhere in this swarm is the queen, and it is now that the bee-keeper comes with a box to catch it. He knows that if he can capture the queen, all the workers in the swarm will come with her. You will see him go to the bough and, holding his box underneath, suddenly shake all the bees into it. There is a swish and a great humming of wings, and bees seem to be everywhere. But the bee-keeper has turned the box over and laid it with one corner on a stone on a sheet of cloth on the ground. If the queen is inside, every worker will come to her, so that by evening, when the bee-keeper returns, he can remove the stone, tie the corners of the cloth together over the box and gently carry the bees home to a hive.

The bees left in the hollow tree are now without a queen—but not for long. Soon one of the queen-cells which the old queen has left behind opens, and out comes a young queen. Until she has mated with one of the drones the young queen cannot lay fertile eggs. After a few days she leaves the hive, *This drawing shows bees inside a hollow tree. Bees arriving alight outside the entrance and crawl in past the guards. Because each nest has its own distinctive smell, the guards can recognize and drive away bees from any other nest. In every nest there are three kinds of bee: a very large number of workers, a few drones, and a queen. These different kinds are shown in detail on the facing page. The workers keep the home clean and gather nectar and pollen from the flowers. They bring the nectar to the hive in their crops, the pollen in little bags on their legs. Honey and pollen are stored in cells to be used for food in the winter.*



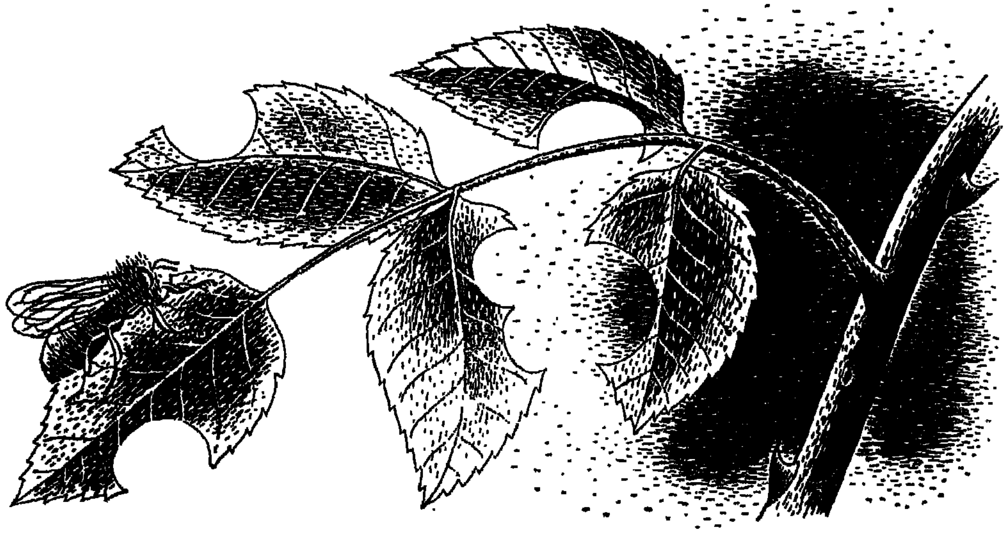


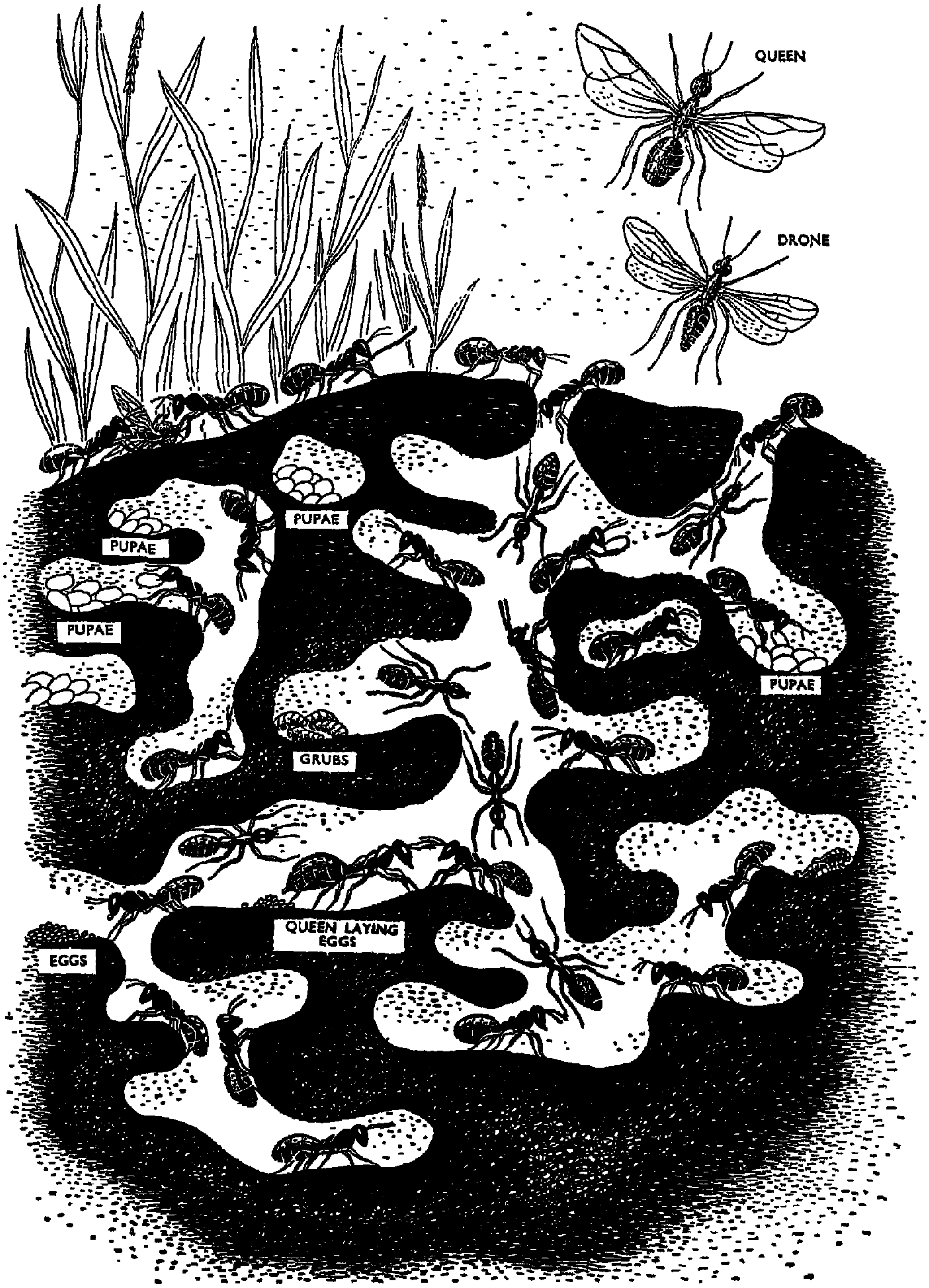
BELOW *is shown a leaf-cutter bee cutting out circles of rose leaf for the floors of her cells. The walls of the cells are made of pieces cut from the edge of the leaf, rolled (as shown in the drawing* ABOVE) *and overlapped so that no gap is left. Each cell is filled with a honey-and-pollen paste on which the bee lays one egg. The cell is then sealed with a rose-leaf lid. The last egg laid is first to hatch and the grub feeds on the paste.*

followed by some of the drones. She mates with one of them, returns to the hive, and can now lay eggs. She may swarm as her mother did, but there are now not so many worker bees to go with her. This smaller swarm is called a cast, and there may be several casts during the summer. At the end of the summer the youngest queen of the season settles down with the workers for the winter.

The drones do not live through the winter, for in the autumn the workers kill them. They stop feeding them, and if you watch a beehive while this is happening you will see grim battles going on as the workers drag the drones, weakened by hunger, to the door of the hive and leave them outside in heaps to die.

Bees are kept not only for the honey which they make out of the nectar of flowers, but also because as they visit the flowers they become dusty with pollen and carry it from flower to flower. This helps the flowers to turn





CROSS-SECTION OF AN ANTS' NEST

into fruit. So fruit-farmers will sometimes pay bee-keepers to put their bees into their orchards at blossom time to make the trees yield more fruit.

Although honey-bees and humble-bees live in colonies, there are some quite common bees that are solitary. Some, like the little golden-yellow burrowing bee, make burrows in the ground, lay a few eggs in them with a little honey and pollen and then leave the youngsters to fend for themselves. The leaf-cutting bees are solitary bees, too. They cut neat round pieces out of rose leaves which they use for making cells for their eggs. They carry these pieces of leaf home: you can sometimes see them going in and out of a hole between the bricks of an old wall. Inside the hole there may be half a dozen cells with grubs in them, but after the young bees have hatched the mother bee takes no more interest in them.

WATCHING THE ANTS

The ants that trouble us because they plant greenfly on our trees are social insects like wasps, humble-bees and honey-bees. You can learn a good deal about how they live if you watch them scurrying about after you have disturbed an ants' nest. Nobody likes to have their home pulled to pieces, and the ants quickly repair the damage. If you watch before they rebuild their nest you can see them picking up little pale-brown things that people call ants' eggs and taking them underground.

These "ants' eggs" are as big as the worker ants that carry them, so, although the queen ant is a little larger than the workers, she would have to be a very clever ant to lay an egg as large as that! The truth is they are not eggs, but ant pupæ, and have come from tiny white ants' eggs that you can hardly see.

THE WORK OF THE QUEEN ANT

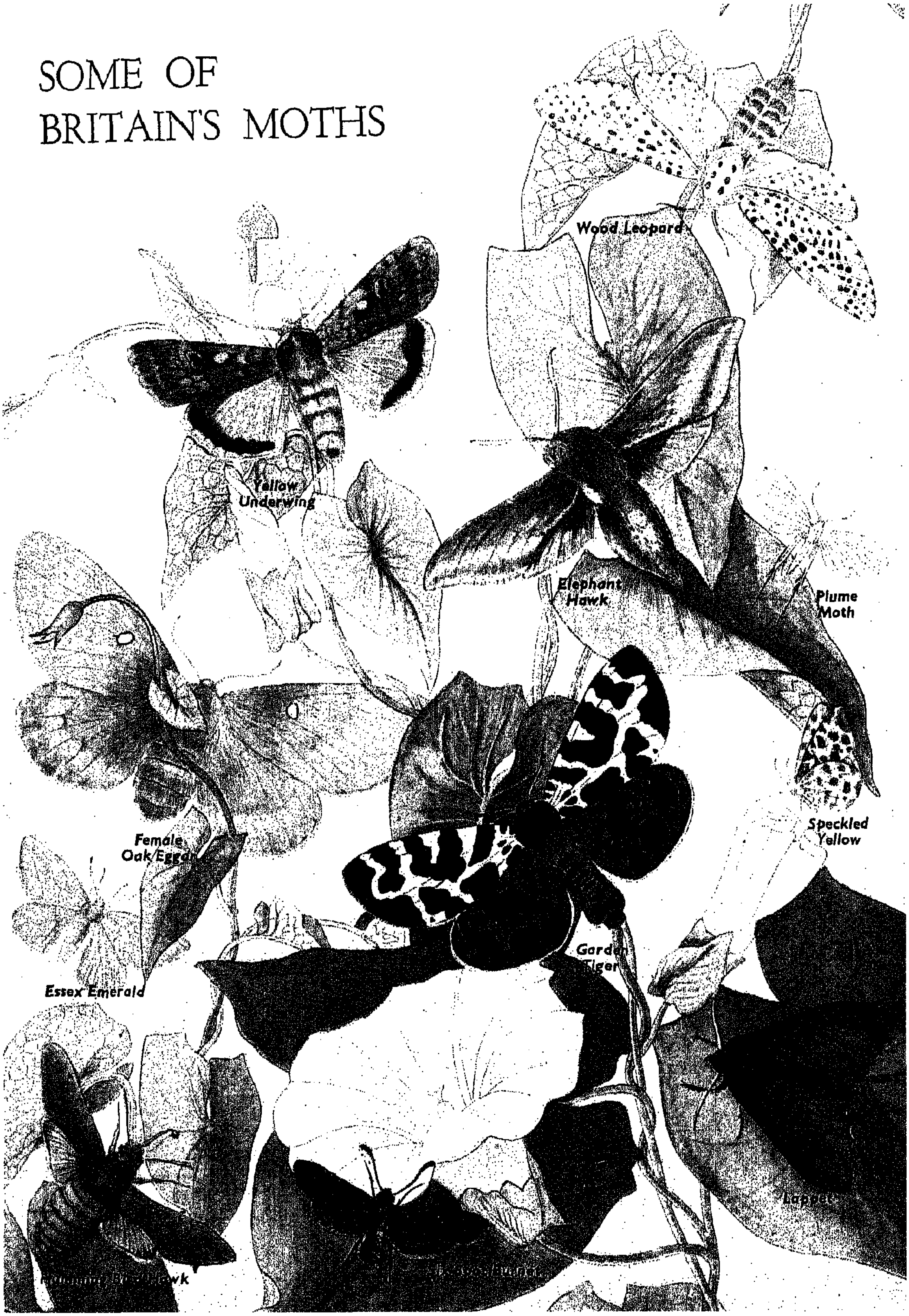
The queen ant lays eggs in the deeper tunnels of the nest. Worker ants pick up the eggs and take them to little rooms leading from the tunnels. They feed the tiny ant-grubs which hatch, and keep them clean by licking them from time to time. When the grubs are fully grown they turn into pupæ, and the workers carry them up to the warmer parts of the nest. Some people collect them for fish food.

During the summer the queen also lays eggs that hatch into princesses and drones. These are the winged ants you sometimes see crawling out of the nests. They fly up into the air, and the princesses and drones mate. The new queens either return to the old nest and help the old queen with egg-laying or start a new nest in the way that humble-bee and wasp queens do. Because they now stay in the nest they do not need their wings, so they pull them off. The drones, however, do not come back; they die after mating.

There are many different kinds of ant. Some sting us and some cannot; some raid other ants' nests and carry off slaves; and some even make friends with other insects which they allow to live in their nests with them. There are very many different kinds of other insects, too, and always more is being found out about them.

INSECT
LIFE
Wasp
Rose Chafer

SOME OF BRITAIN'S MOTHS



British butterflies

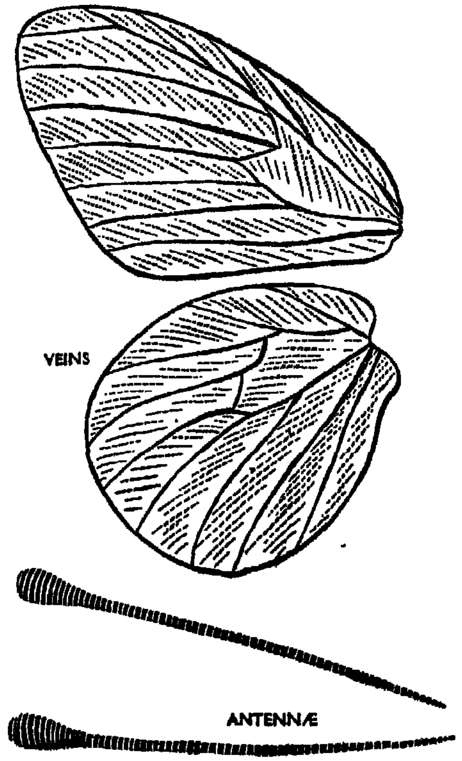
When you see butterflies, do you sometimes wonder where they come from, how they live, and where they are going as they flutter about? Everybody knows the white butterflies but not so many people know where they come from, or where they go to in the winter. These white butterflies are by no means the only ones that you can see, for there are over sixty different kinds living in Britain. Some, like the meadow brown, are even commoner than the white ones, some are rarer, and some live only in certain parts of the country.

If you catch a butterfly you will see that, like many other insects, it has a head, a body, legs and two pairs of wings. On its head it has two large, bulging eyes, a pair of long feelers, and a long tongue coiled up underneath like a watch-spring. A butterfly uses its feelers not only for feeling things, but for smelling as well, and if you gently uncoil its tongue with the tip of a needle you will see that it is almost as long as these feelers. This tongue is hollow, and the butterfly uses it for sucking nectar from the flowers that it visits.

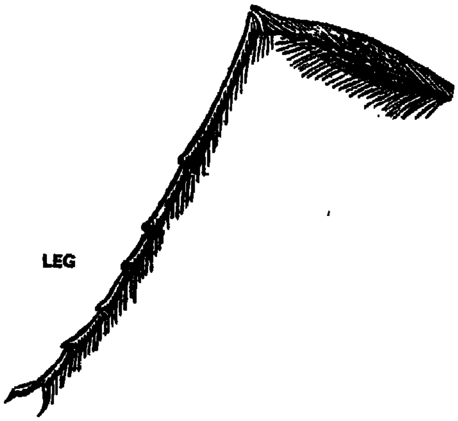
Now look at the butterfly's slender body. You can see that the two pairs of wings are attached to the front of it, as are also the three pairs of slim, pointed legs. The wings are covered with a dusting of fine scales, which sometimes come off on your fingers as you handle the butterfly, and on the butterfly's body you can see a covering of hairy bristles. Scientists believe that these help the butterflies to hear sounds, but they also know that these insects cannot hear very well. The insect's feet are interesting, because it not only uses them when it settles, for holding on and walking, but also for tasting; and later you will see how the female butterfly especially finds this useful. Another strange thing about butterflies is that although they use their mouths for feeding, as you would expect, they never use them for breathing. Instead, they have holes along the sides of their bodies.

So butterflies have odd ways of doing some things, and some people say that they smell with their feelers, hear with their whiskers, taste with their feet, and breathe through their sides.

Butterflies are similar to moths in many ways, but you should be able to tell the difference between them. It is easy if you remember that their bodies are different, that their feelers are



Butterflies' wings are sturdier than they look because they are strengthened with horny bars called veins. The pattern of these veins helps in distinguishing the different types of butterfly. The wings are covered with tiny scales which give the wing its colour. The feelers, or antennæ, of butterflies are always knobbed like those shown: very few moths have knobbed feelers. Butterflies' legs (SHOWN BELOW) *are covered with tiny bristles which are believed to enable the insects to hear.*



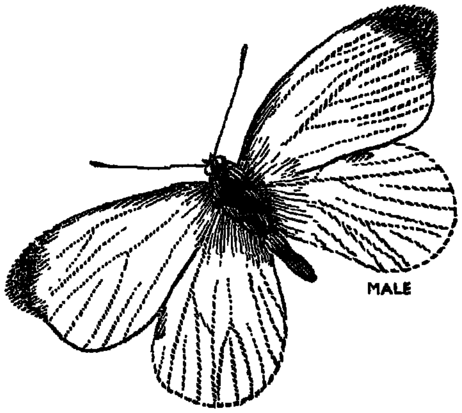
different, that as a rule they fly at different times, and that they settle in different ways. Butterflies have slender bodies, as you know, but nearly all moths are rather stouter around the waist-line. All butterflies' feelers have little round knobs at the ends, while those of moths are all sorts of shapes and seldom have knobs on them. Again, while all butterflies fly by day, and usually rest at night, most moths are night fliers and hide away in the daytime. The last difference is that when butterflies come to rest they fold their wings together upwards, so that they stick up from the body like the sail of a boat, while moths never do this, and either spread their wings out flat or fold them tent-wise over their bodies.

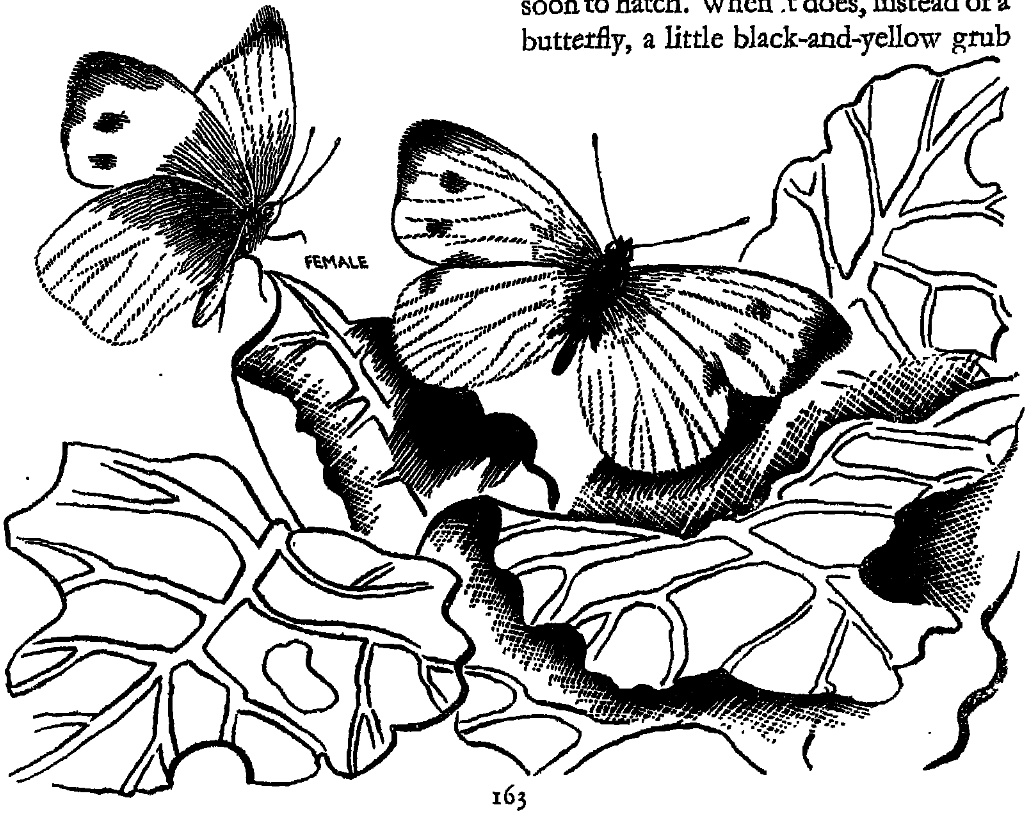
But these differences are not quite hard and fast, and among the two thousand different kinds of moth there are some exceptions. For instance, the burnet moths fly in the daytime and have feelers that are thickened at the ends rather like those of butterflies. These moths have shiny black wings splashed with vivid scarlet spots, but they give themselves away, for they settle as a moth should. Some butterflies occasionally do this as well, and you sometimes see peacock, small tortoiseshell, and skipper butterflies feeding from the flowers with their wings spread out flat.

Now let us find out something about where butterflies come from and how they spend their time. We can learn a great deal by watching white butterflies. Everyone knows them, and from early spring until late summer you will see them fluttering about, sometimes singly and sometimes in dancing pairs. Every so often one will settle on a flower and take a sip of nectar; but if you go into a garden where cabbages are growing you will see many more of these butterflies —especially on warm, sunny days. There may be hundreds of them fluttering among the cabbages, and resting on plants in order to lay their eggs.

In the early spring these butterflies come out and lay their tiny golden eggs on the undersides of cabbage leaves. If you turn the leaves over you can see the neat rows of eggs in groups, and there may be as many as a hundred of these eggs in each group. After a few days you will notice that each egg has a tiny dark spot at its tip, and this tells you that it is soon to hatch. When it does, instead of a butterfly, a little black-and-yellow grub

Though the cabbage-white butterfly cannot eat cabbage leaf, it is believed to be able to taste it through the tips of its hind feet. It is in this way that the butterfly about to lay eggs picks out the kind of leaf which will provide suitable food for the caterpillars when they hatch.





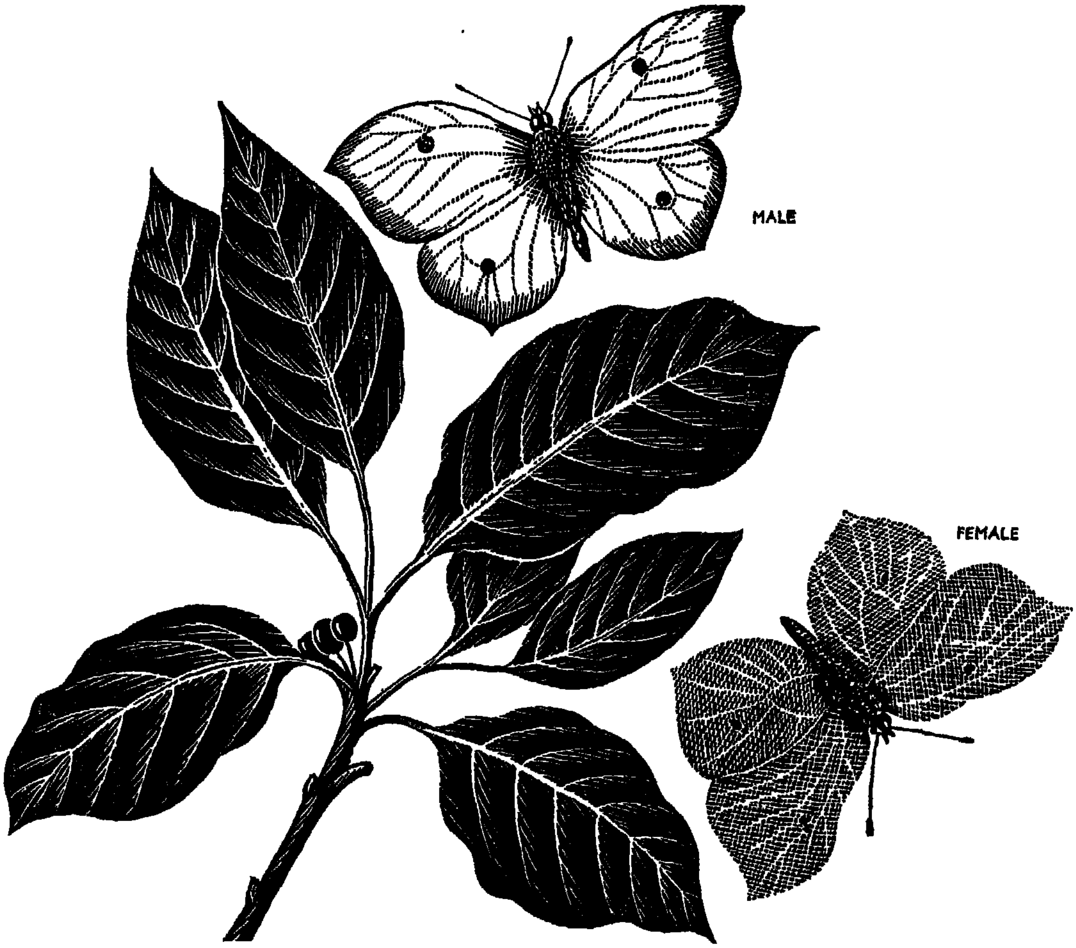
comes out; its dark head had shown through the tip of the egg before it hatched. These black-and-yellow grubs are called caterpillars, and as soon as they hatch they eat their own egg-shells. Then all the caterpillars lie huddled together, feeding on the cabbage leaf.

At first you do not notice much damage to the plant, because the small caterpillars do not each much. But as they grow, so do their appetites, and they may eat more than their own weight of cabbage leaf in a day. They grow so rapidly that their skins quickly become too small for them, so they burst out of them after they have grown new soft skins underneath. You can see their moulted skins lying about on the infested leaves, and some people mistake them for dead caterpillars. They moult four or five times as they grow, and when it is about an inch and a half long each black-and-yellow caterpillar crawls into a sheltered place. Here it spins a little silken mat to which it sticks its head, and weaves a little silken girdle so that it is also slung by its middle to its resting-place. Then it moults once again, but this time, instead of a caterpillar, something smooth, glossy, pointed at both ends, and speckled with grey or brown to blend with its hiding-place, comes out of the caterpillar skin. This is called a chrysalis, and the wonderful thing about the chrysalis is that it is able to get out of the caterpillar skin without tearing the silken mat or the girdle.

When she has found a suitable leaf the female cabbage-white butterfly grips it with her feet and curving her abdomen touches the leaf with its tip. Out comes a tiny egg which sticks to the leaf. She may lay up to one hundred eggs in one place.

The chrysalis lies very still, and you might think it dead. But if you touch it you will see its pointed tail end give a sudden sideways jerk, as though angry at being disturbed. Although it lies very still, much is happening inside the chrysalis; and at the end of about three weeks it suddenly splits along its back, and out crawls a rather damp and crumpled butterfly. As you watch it, it dries itself in the warm air and spreads its wings. Although these butterflies fly clumsily, they can cover enormous distances, even flying from France.

These butterflies that hatch out are the ones we see in July and August; and they spend their time flying about, sipping nectar and laying more eggs on our cabbages and other greens. They do not

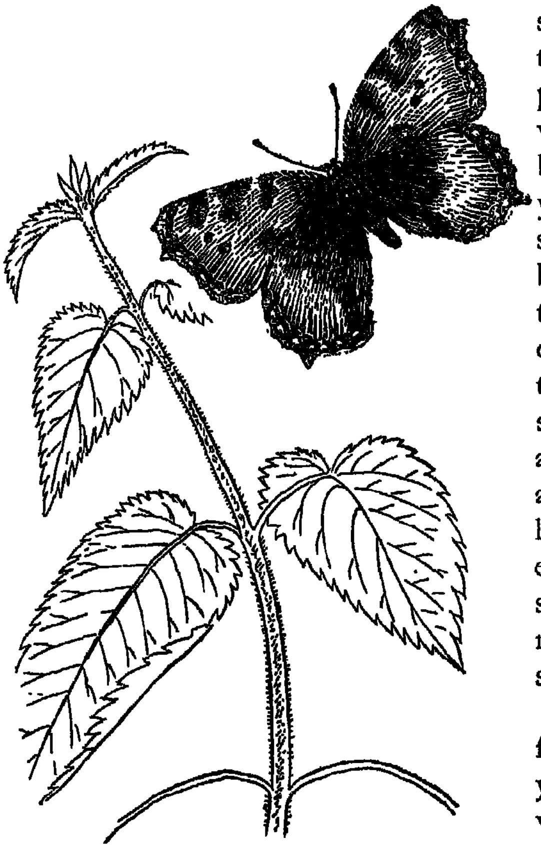


One of the longest lived of British butterflies, the brimstone, hibernates through the winter and may again be seen flying about during the summer after that in which it hatched. The female (BOTTOM), *greener in colour than the male* (TOP), *lays her eggs on the leaves of buckthorn* (LEFT).

need much food themselves, for they do not grow, so the nectar from the summer flowers keeps them going. But the caterpillars which come from their eggs devour our greenstuff and turn into chrysalises which rest through the cold days of winter.

Many people do not realize that there are two common cabbage-white butterflies. The one that you notice most often is the large white, with its yellow, black-spotted caterpillars that feed in groups. But on the same cabbage plants you will also find smaller green caterpillars. These are the caterpillars of the small white butterfly. While the large caterpillars are easy to see, the small ones are difficult, and it is only after careful searching in the heart of the cabbage that you find them. They look very like the leaf on which they feed, and you seldom find more than two or three together.

Now, both the large and small white caterpillars grow fast enough for the



Toward the end of the summer months the small tortoiseshell butterfly may be found sipping nectar from dahlias and Michaelmas daisies, but in spring and early summer it is more common among stinging nettles where the eggs are laid.

butterflies to become grandparents in one season. The eggs that they lay in the spring hatch, and the caterpillars grow into butterflies, which in turn lay eggs. This ,summer brood of eggs produces caterpillars which grow until the cold weather, when they turn into chrysalises, and in this way pass the winter.

Not all caterpillars grow as fast as this. For instance, the brimstone butterfly has time for only one brood of eggs in a year. In April or May, when you see these butterflies about, you can be fairly sure that growing nearby is a hedgerow tree called buckthorn. This is the food-plant of the brimstone caterpillar, and when the female butterfly settles to lay her eggs underneath the buckthorn leaf you will see that the veins on her wings stand out more than they do on most butterflies. The brimstone's front wings, too, are rather unusual. Unlike those of other butterflies, they curve round at the front and come to a point on each side. Its smooth green caterpillar grows and changes into a greenish chrysalis; and soon out comes the butterfly. This happens fairly late in the summer, but even before the cold weather the brimstone has gone to hibernate or lie dormant for the winter under the leaves on some ivy-clad tree trunk or wall.

Small tortoiseshell and peacock butterflies also pass the winter in this way, and you sometimes find them lying on window-sills inside your house and in old sheds and buildings. Even if you pick them up they seem to be dead and do not move; but, like the brimstones, in the spring they come out and fly about in the warm weather. People sometimes tell you that butterflies live for only one day, and they do look so delicate that it is hard to believe that any of them could live very long—let alone stand up to the cold and damp buffeting weather of winter. But, of course, some of them can, and the brimstone is probably one of the longest lived of all British butterflies. So when you next hear people make this mistake tell the story of the brimstone; how it hatches late in the summer of one year, hibernates through the winter, and flies until the summer of the following year. It would indeed be an unlucky butterfly whose life was cut as short as one day.

Although brimstones grow fast enough to become adult butterflies by winter, the caterpillars of the orange-tip butterfly grow more slowly and do not get even as far as that. Like the brimstone, the orange-tip has only one brood of eggs in a season, and its slowly growing caterpillars get only as far as to change into chrysalises by the autumn. This butterfly is first on the wing in April or May, but when you see its white wings with their flashing orange wing-tips it is no use following their owner to see where the eggs are laid, for this fellow never lays any eggs. He is a male, and, instead of the orange mark, the wings of the female have only grey patches. She lays her eggs singly on the leaves of plants like horse-radish or charlock, and as she settles among them you can see that the under sides of her wings, like those of the male, are speckled with green, so that she is well

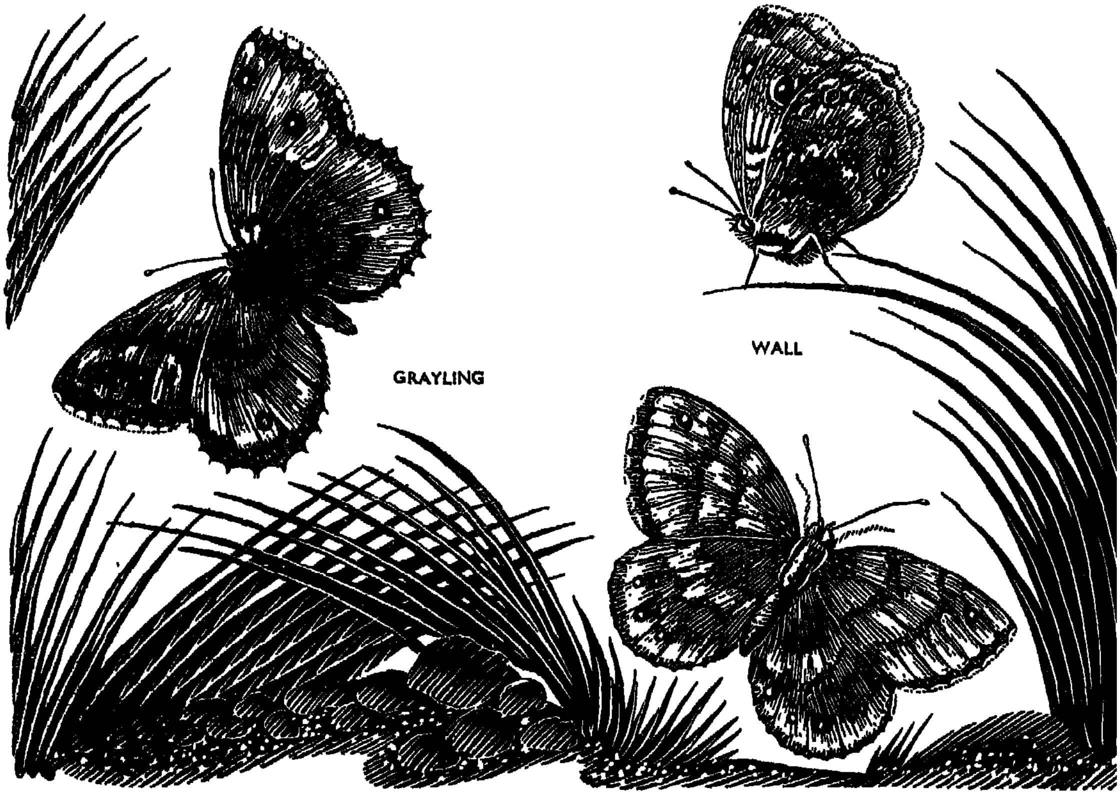
On gently twinkling wings the orange-tip butterfly flies slowly and steadily. The female resembles the cabbage-white butterflies for she has no orange on her wings; it is from the colouring of the male that the insect gets its name.

hidden. The dark-green, somewhat hairy caterpillar grows slowly, and it is not until fairly late in the summer that it turns into a chrysalis that rests through the autumn and winter. Then late in the following spring the orange-tip butterflies hatch and are on the wing again.

You can see now that the caterpillars of different butterflies grow at different rates. But the rate at which they grow depends partly on how much food they eat and on how nourishing it is—and some foods are more nourishing than others. So let us find out something about some of the different kinds of food that caterpillars live on.

Most caterpillars are very particular about food and will thrive only if they are brought up on the right kind. For a long time, therefore, people wondered how butterflies—who do not, of course, feed on leaves—were able to tell where to lay their eggs so that the caterpillars should hatch out on the right kind of leaf. We can see now how being able to taste with her feet is probably useful to the female butterfly—she is able to taste the leaves as she walks over them, and can therefore tell when she has found a suitable place for her eggs.

Most butterfly eggs hatch fairly soon, and many caterpillars make their first meal from their shells. This horny eggshell provides the caterpillar with the food which enables it to spin some silk, which caterpillars always find useful—



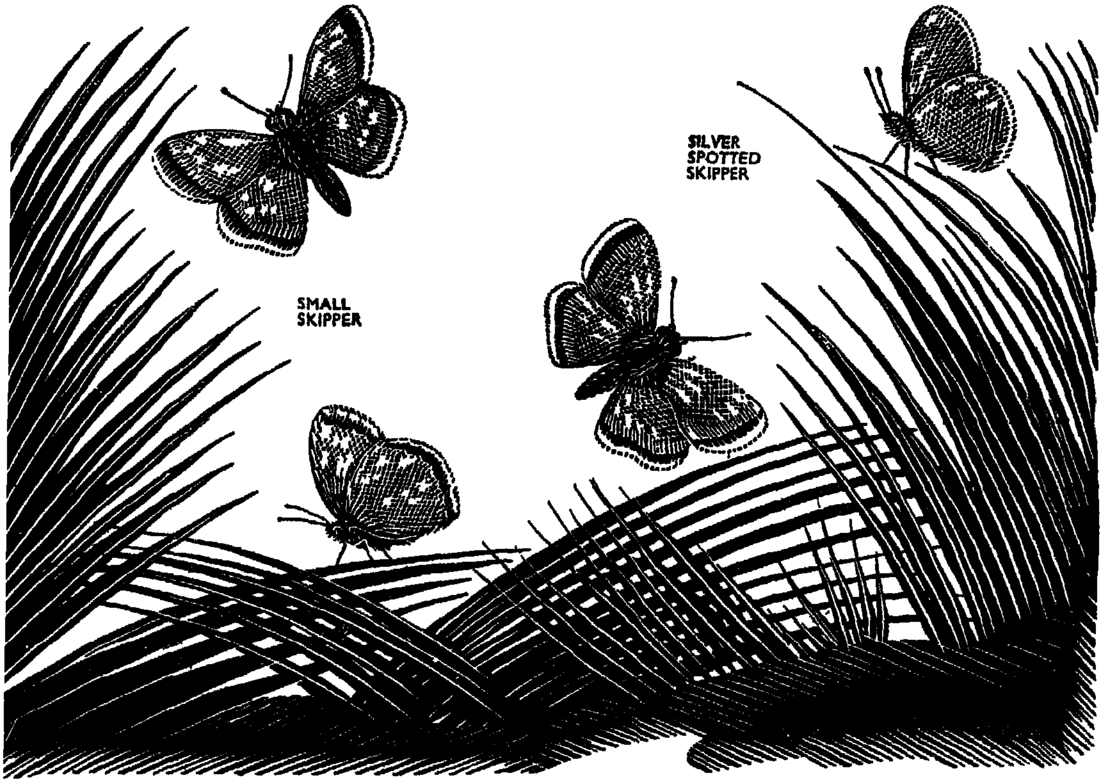
especially if they wish suddenly to swing down out of sight from an enemy. When it has eaten its egg-shell, the caterpillar sets to work to eat as much of its food-plant as it possibly can.

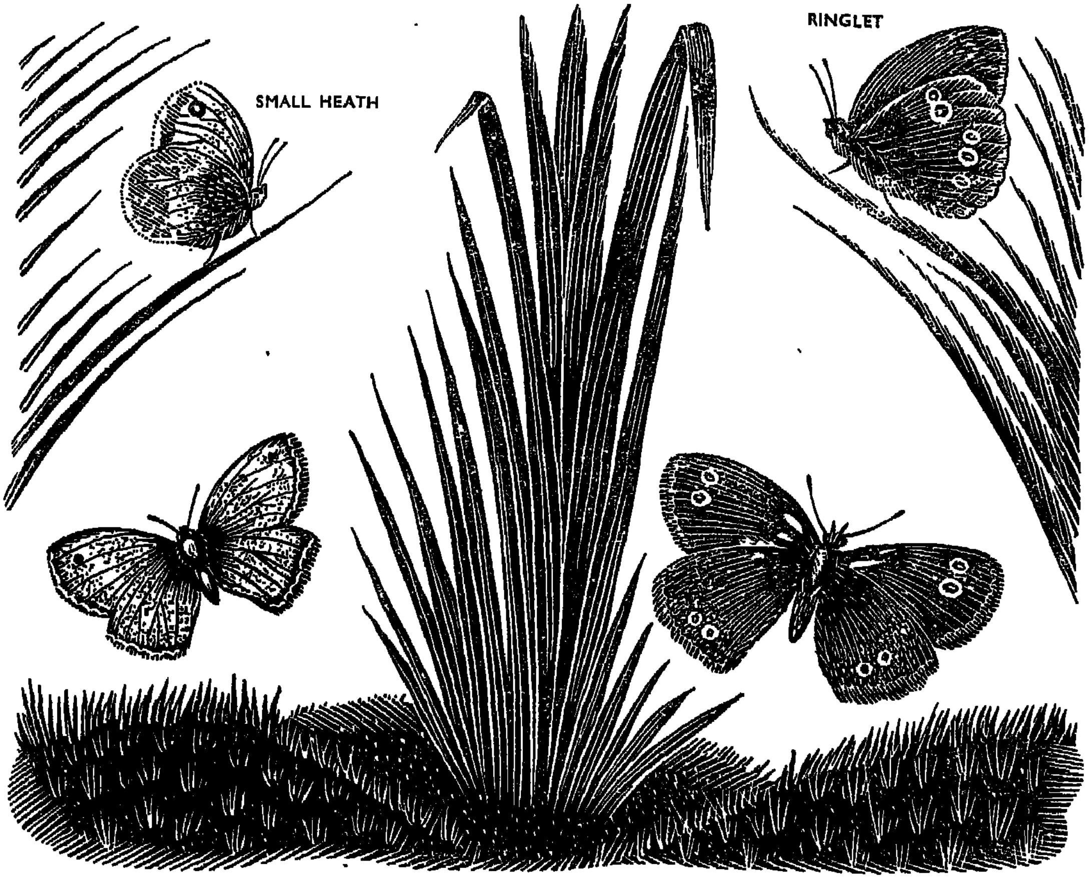
Other caterpillars, like those of the peacock, the small tortoiseshell and red admiral butterflies, feed on stinging-nettles, and you sometimes see crowded masses of the caterpillars on the nettles, eating the leaves. It is strange that these leaves that make us so sore when we touch them never seem to harm the caterpillars, who instead do great damage to the nettle plants.

Caterpillars that eat weeds in this way help the farmers and the gardeners. Of the other weed-eaters, the orange-tip caterpillars feed on charlock, those of the small copper eat dock and sorrel leaves, and the painted lady's caterpillars attack thistles. But many of the common butterflies have caterpillars that live on the different kinds of grass growing in meadow and pasture. So when you are looking for these butterflies you will often find that the best places for them are the neglected parts of commons, for the grasses there are not disturbed, as they are in a farmer's fields.

Here you will find the grayling, the wall and the marbled white butterfly, the

The butterflies shown BELOW *are usually to be found in meadow and pasture-land because their caterpillars feed on the leaves of grass.*





The small heath (UPPER AND LOWER LEFT) *and the ringlet* (UPPER AND LOWER RIGHT) *are both butterflies which lay their eggs among grass, on which the caterpillars feed. The caterpillars pass the winter huddled in the grass and feed up in the spring before passing into the chrysalis stage.*

meadow brown, the heath, the ringlet, and the small copper. Here, too, are to be seen the different kinds of grass-loving skippers, whose darting flight makes them difficult to catch; and though its caterpillars are not grass-feeders, but live on bird's-foot trefoil, you will find the common blue in many fields as well. Some of the butterflies, like the ringlet and marbled white, do not even bother to lay their eggs on the grasses, but dribble them out behind as they fly low over the fields; and the caterpillars hatch out and climb on to their food-plant, which is, of course, never far away. They grow during the summer months, and while the marbled white turns into a chrysalis for the winter, the ringlet, like some of the others, hibernates as a caterpillar huddled among the grass-roots. Caterpillars, then, live entirely on the leaves and stems of plants, and have strong jaws to bite their food.

There is, however, one exception, and the story of how that one lives is indeed strange. For many years people knew that the rather rare large blue butterfly lived only in the south of England and seemed to like limestone and chalk hill-country. People had noticed, too, that it laid its eggs on wild thyme, and after it had moulted a few times the small pink caterpillar behaved in a curious way. Instead of munching contentedly at the thyme leaves, it became restless, clambered down to the ground and, wandering about, would now and then try to burrow into the soil. Nobody really knew what happened after that, although several people had found chrysalises in the soil and had hatched out large blue butterflies from them. There matters remained for several years, until by very careful watching people collected together, bit by bit, the full story.

ANTS FEED THIS CATERPILLAR

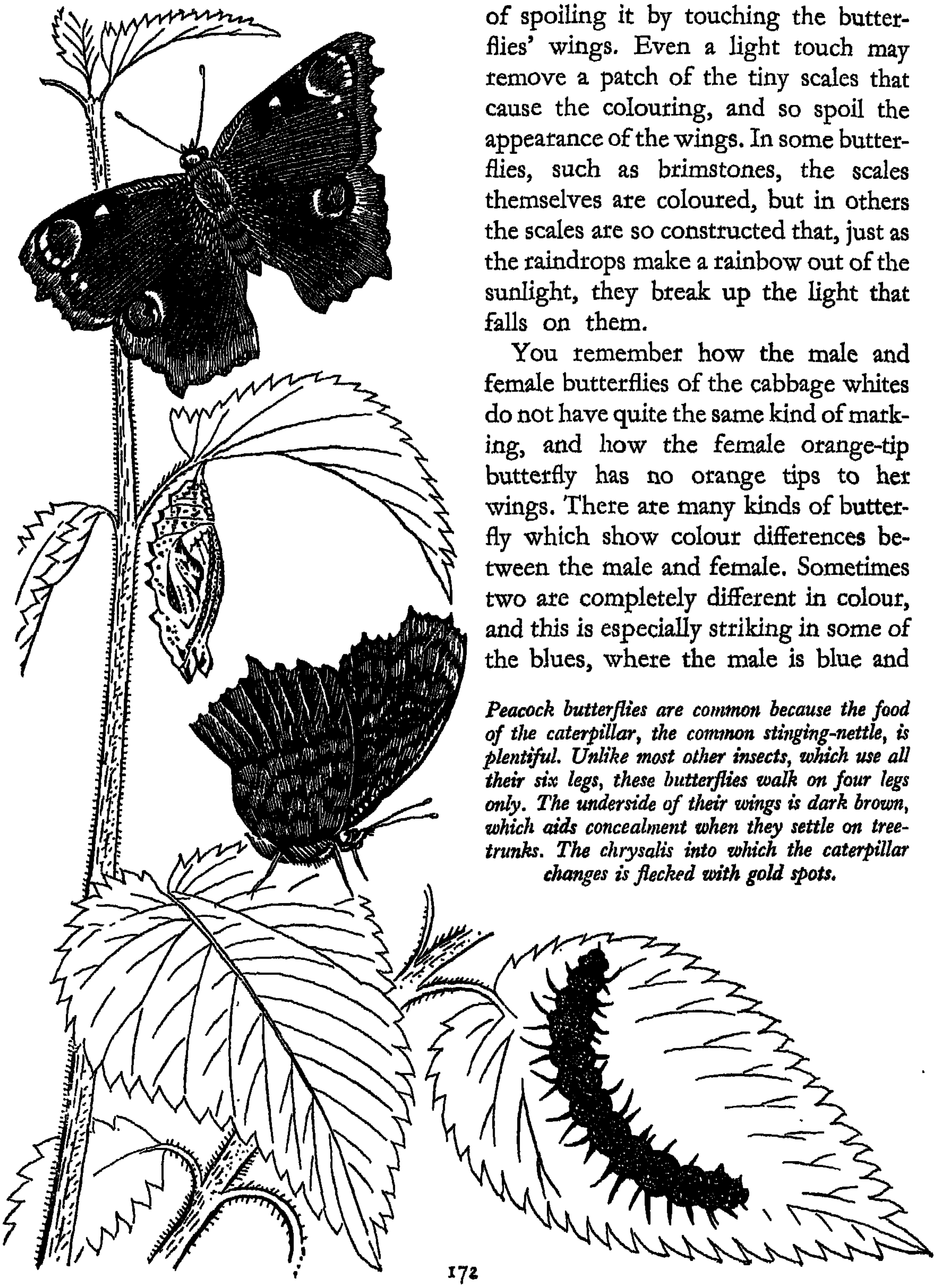
After the caterpillar reaches the ground and crawls about, an ant comes along and strokes the caterpillar with its tongue. The caterpillar replies by giving out a drop of sweet, sticky liquid from a special place on top of its back. This the ant joyfully licks up. This game of stroke and lick goes on for a short time, until suddenly the caterpillar hunches itself up—rather like a cat does when it meets a too-friendly dog—but this does not frighten the ant, which then picks up the caterpillar by its arched back and carries it down a hole into its nest. There the other ants look after it, make it comfortable and feed it, and—this is the strangest part of the story—they feed it on their own living babies! There the lazy caterpillar sits, getting fat on the grubs that the ants bring it, and now never doing anything in return. It rests safe and sound in the nest all through the winter, and in the spring turns into a chrysalis. Soon afterward it hatches from the chrysalis and, keeping its wings folded round its body, calmly leaves the ants' nest, where it has been so well treated. Once in the open air, it spreads its wings, there is a flash of steely-blue, and the large blue butterfly takes to the air and makes off.

HOW BUTTERFLIES FEED

All caterpillars, then, except this one, live entirely on vegetable food and need strong jaws to chew it up. But the butterflies that grow from them do not need these powerful jaws, as they feed on juices of various kinds. Many of them suck the nectar of flowers, and you often see peacock and small tortoise-shell butterflies poking their long tongues into lilac and other garden blossoms. Red-admiral butterflies also enjoy the juices that run from rotting fruit, and you sometimes see them busy in orchards on over-ripe plums as they lie on the ground. Perhaps the strangest from this point of view is the purple emperor. This lovely butterfly is not common, and spends much of its time hovering around the tree-tops; but it will gladly come down to earth to drink its favourite brew—the evil-smelling juices from the decaying body of an animal that has died in the woods!

Although many people admire the lovely colouring of the purple emperor and the other vividly patterned butterflies, they sometimes make the mistake of spoiling it by touching the butterflies' wings. Even a light touch may remove a patch of the tiny scales that cause the colouring, and so spoil the appearance of the wings. In some butterflies, such as brimstones, the scales themselves are coloured, but in others the scales are so constructed that, just as the raindrops make a rainbow out of the sunlight, they break up the light that falls on them.

You remember how the male and female butterflies of the cabbage whites do not have quite the same kind of marking, and how the female orange-tip butterfly has no orange tips to her wings. There are many kinds of butterfly which show colour differences between the male and female. Sometimes two are completely different in colour, and this is especially striking in some of the blues, where the male is blue and

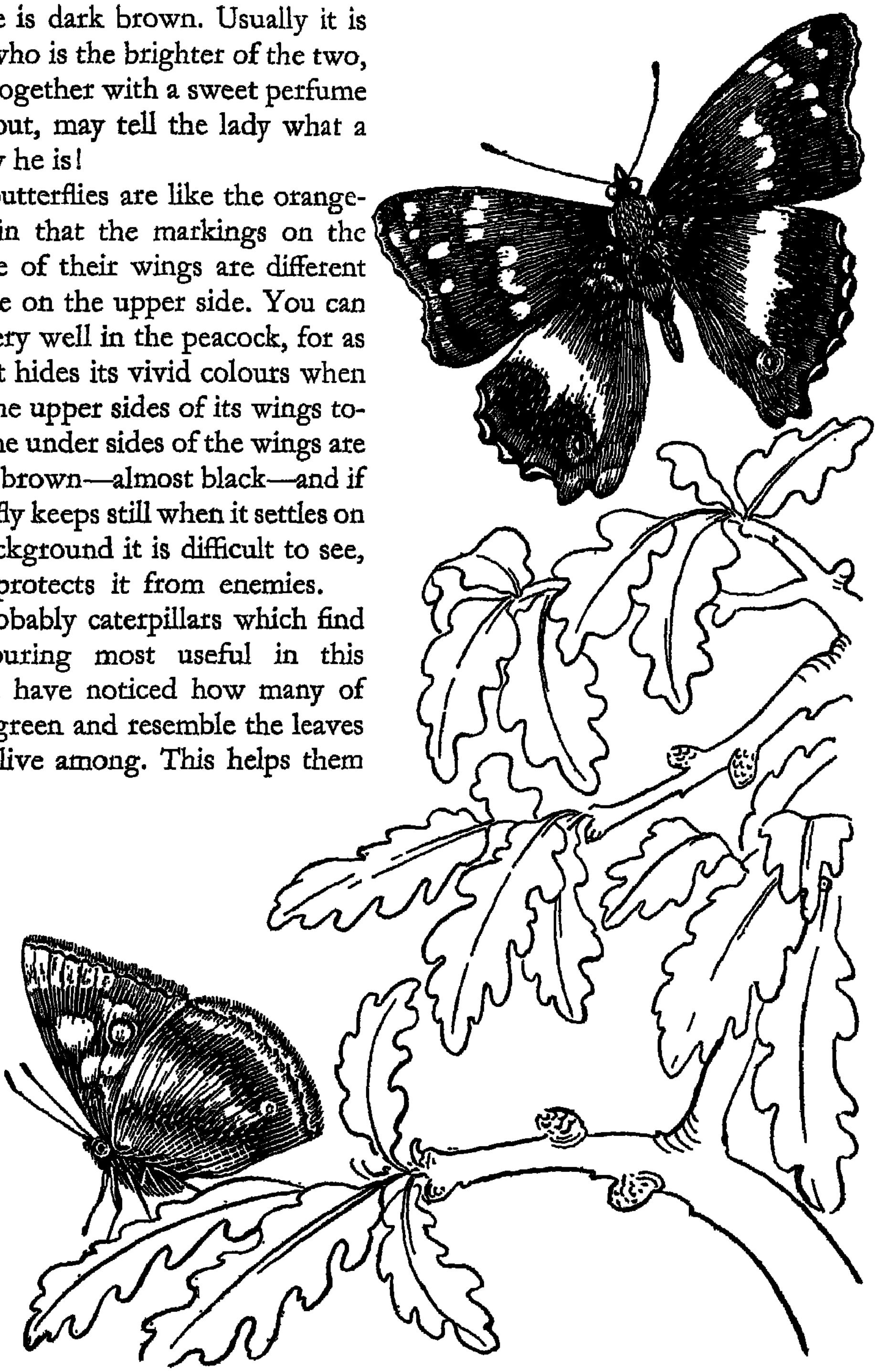


Peacock butterflies are common because the food of the caterpillar, the common stinging-nettle, is plentiful. Unlike most other insects, which use all their six legs, these butterflies walk on four legs only. The underside of their wings is dark brown, which aids concealment when they settle on tree-trunks. The chrysalis into which the caterpillar changes is flecked with gold spots.

the female is dark brown. Usually it is the male who is the brighter of the two, and this, together with a sweet perfume he gives out, may tell the lady what a fine fellow he is!

Many butterflies are like the orange-tip, too, in that the markings on the under side of their wings are different from those on the upper side. You can see this very well in the peacock, for as it settles it hides its vivid colours when it closes the upper sides of its wings together. The under sides of the wings are very dark brown—almost black—and if the butterfly keeps still when it settles on a dark background it is difficult to see, and this protects it from enemies.

It is probably caterpillars which find their colouring most useful in this way. You have noticed how many of them are green and resemble the leaves that they live among. This helps them



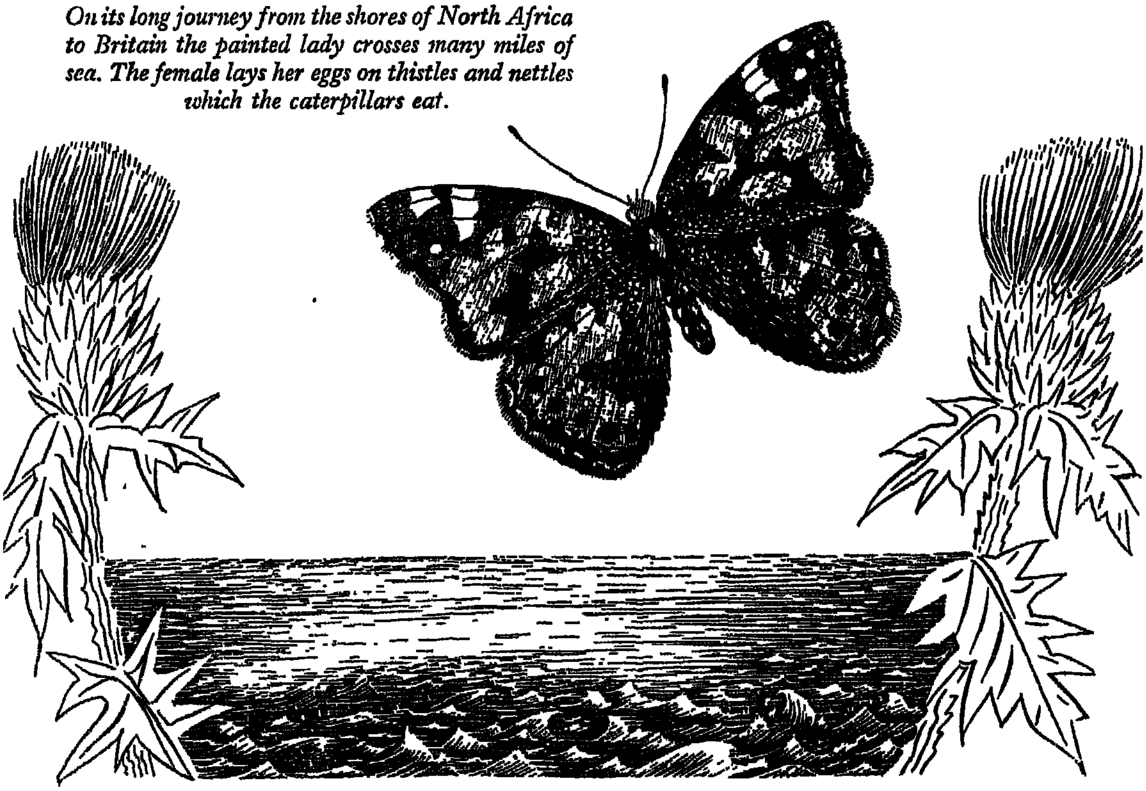
High among the branches of oak trees flies the purple emperor, a butterfly which is beautiful but very shy. It is one of the few butterflies which feeds on dead animals.

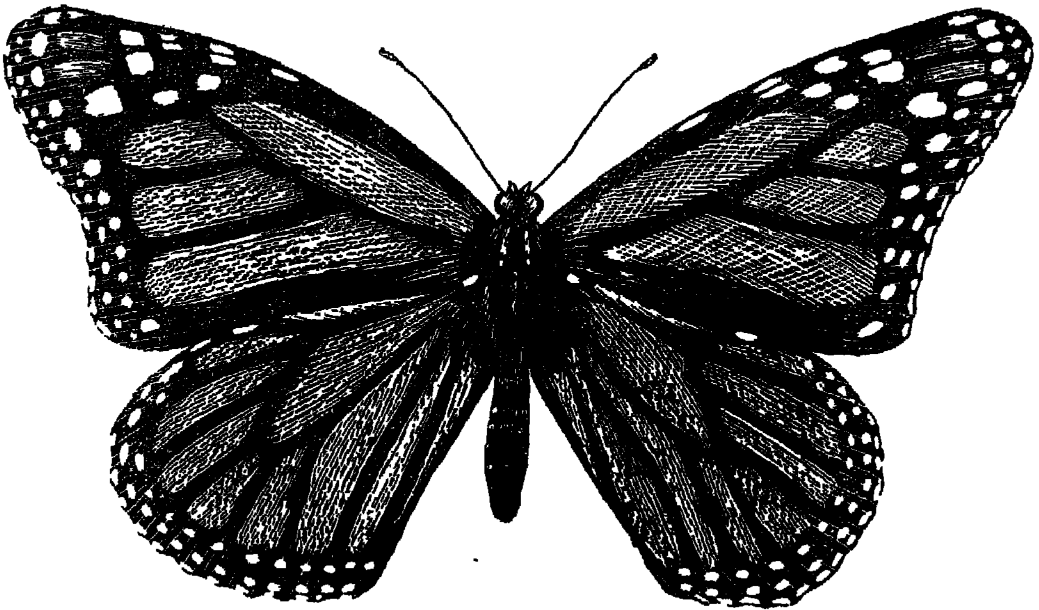
to hide from their enemies, who need sharp eyes to find them. But some caterpillars, instead of being coloured so that they blend with their surroundings, are strikingly coloured, live together in large groups and are easy to see.

The black caterpillars of the peacock butterflies show up clearly on nettle-plants, and no one can overlook the caterpillars of the large white on cabbages. Some people think that these caterpillars are brightly coloured and easy to see in order to warn their enemies that they have a horrid taste; and this may well be so, for while few enemies seem to trouble the large caterpillars, the case is very different with the small green ones. As you lie watching the cabbages you will see a wasp buzz into view and, paying little heed to the large spotted caterpillars, swoop down into the heart of the plant and pounce on a small green one that you can hardly see; then, holding its wriggling burden in its jaws, it hurries back to its nest.

Not only wasps but birds as well attack some of the caterpillars, and also the grown-up butterflies. All through their lives butterflies have to face enemies. One of their most serious foes is much smaller than they are, and though many people have seen them they usually do not know what they are. Small insects called ichneumons lay their eggs inside the growing bodies of the caterpillars, and soon out hatch

On its long journey from the shores of North Africa to Britain the painted lady crosses many miles of sea. The female lays her eggs on thistles and nettles which the caterpillars eat.





Though common in some parts of Australia and America the monarch or milkweed butterfly is seen only seldom in Britain. No one really knows how it gets there. Though it has been seen on the wing far out at sea there is no certainty that it can fly the Atlantic Ocean. Perhaps eggs or caterpillars sometimes find their way to Britain on ships.

some little maggots. These maggots feed on the inside of the caterpillars' bodies, but so arrange matters that they never kill the caterpillars too soon. Ichneumon eggs must be very small, for there may be as many as a hundred of them laid inside each caterpillar, which, just as it is about to change into a chrysalis, dies, and out come the little squirming ichneumon maggots. Each one settles down near the dead caterpillar and spins itself a silken case, inside which it slowly changes into an adult ichneumon. So when you see these little golden, barrel-shaped, silken cases you will know what they are, and that they are a help to us in our gardens.

In good years you will sometimes see great companies of small tortoiseshell, peacock and white butterflies, flying in a very determined way. No longer do they flutter aimlessly about in ones and twos, but suddenly a great cloud of the butterflies appears, and off they stream in the air in a great procession. Often they do not go far, and after a time the company breaks up into small groups which spread out over the countryside.

When butterflies (or any other animals) move from one place to another in this way we say that they are migrating. Migrating butterflies are commoner than most people think. In the spring and summer, watchers on the southern shores of England have seen great clouds of white butterflies making their way across the Channel from France.

Stranger still, some butterflies take the trouble to fly to Britain from warm countries abroad, only to be killed by the cold and damp winters. Every year some clouded yellow butterflies cross the water from the Continent during April and May. They lay their eggs on clover, and the green caterpillars grow quickly and soon change into chrysalises and then into butterflies; and there is often more than one brood in the season. In some years the invasion is tremendous, and in some districts when this happens there may be more clouded yellow butterflies than any others.

MYSTERIOUS MIGRATIONS

Even more puzzling is the case of the painted lady. This gorgeous, rich, orange-coloured butterfly makes the long and dangerous journey all the way from the north coast of Africa to Britain. Much of its journey is over sea and many must perish on the way. Yet most of those that get here look quite fresh and undamaged, as if they had just hatched from their chrysalises. What advantage this is to the butterfly no one knows; or why it leaves the warm and sunny climate of its home for one that may be anything but warm and sunny. The painted lady butterfly lays its eggs singly on thistles and nettles, and the caterpillars, like those of some other butterflies, have the curious habit of making themselves a little nest by tying the edges of the leaf together with silk. There are two, or even more, broods in a season, but these, like the clouded yellows, do not usually live to the following year.

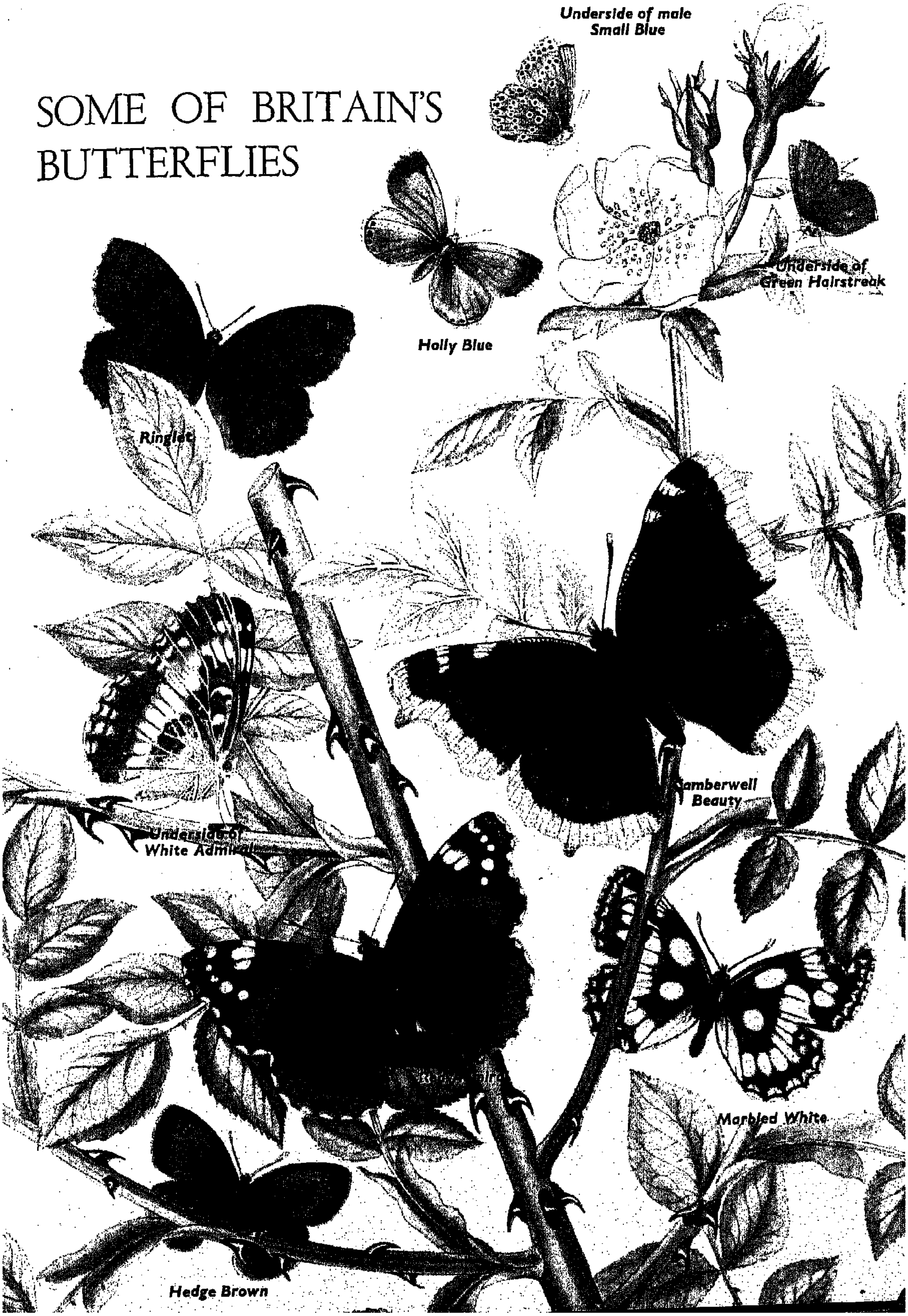
Most mysterious of all migration mysteries is that of the monarch butterfly. For many years people have been puzzled by it. This butterfly is very rare in Britain, but those few people who have seen it in Britain could never have mistaken it for any other. It is much larger than any other British butterfly, and its orange-coloured wings are tough and almost leathery. How it lived nobody knew, for it seemed to lay no eggs, and no one had seen its caterpillars or chrysalises in the countryside. We do know, however, that the monarch is very common in some parts of America, where it lays its eggs on a plant called milkweed. Milkweed does not grow in Britain, and this explains why the monarch lays no eggs there.

A MODERN EXPLANATION

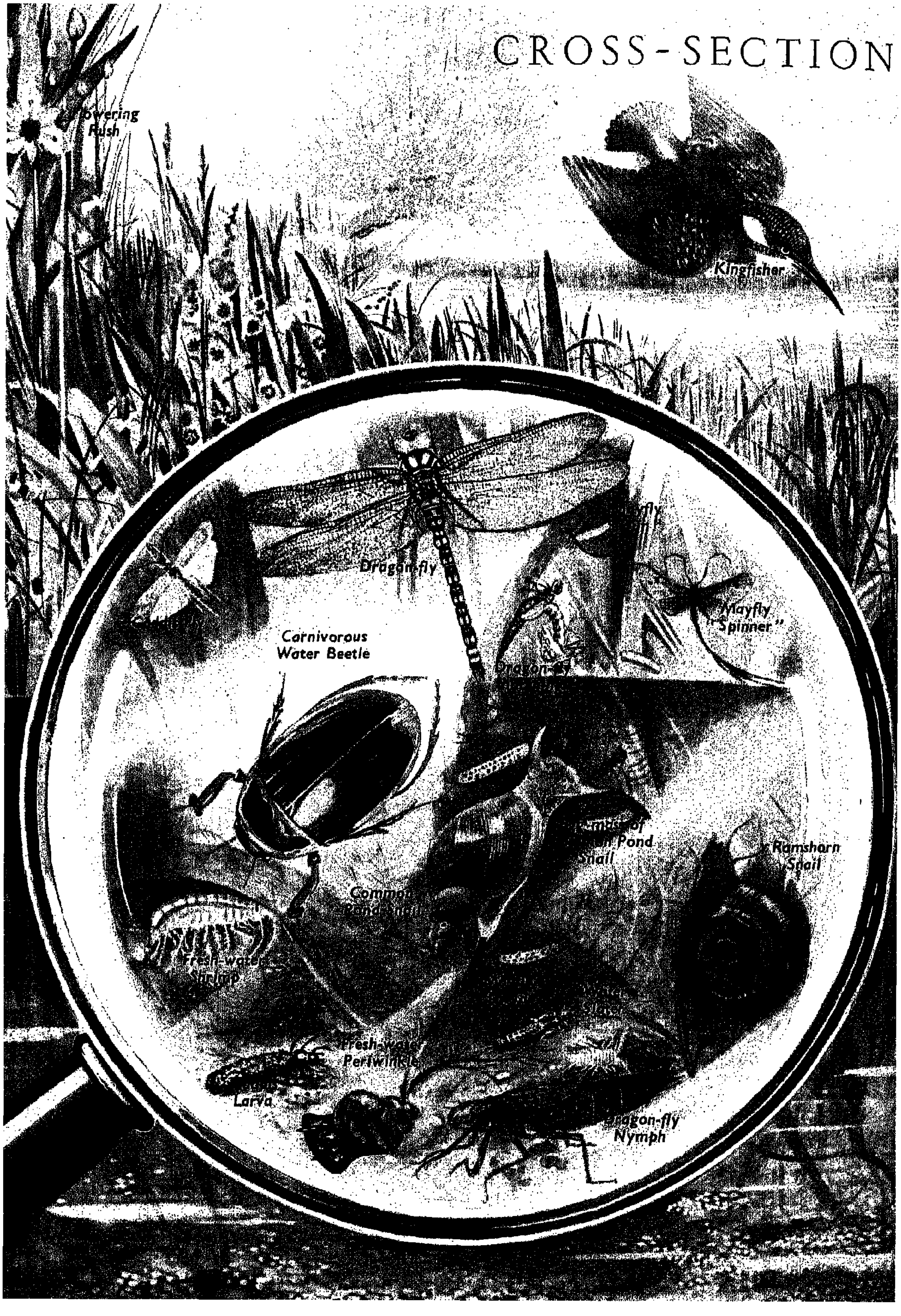
For a long time many people thought that, like the painted lady, the monarch migrated to Britain—even though this meant flying the Atlantic Ocean. This would be a tremendous flight, and it is just possible that the butterflies actually make it; but the mystery remains, as no one has yet proved that this does happen, and nowadays many people think that the butterfly travels in ships' cargoes. No one, however, really knows the truth.

Now that you know something about butterflies you can see that there are still many more things to find out. As you search the fields and the downlands, the woods and the hedgerows, you will discover much that has not been told here about these and other butterflies besides; and when you catch a butterfly, do remember that most of them are harmless animals; so if it is a very rare one like the Camberwell beauty, one not needed for your collection, let it go again so that others may enjoy it.

SOME OF BRITAIN'S BUTTERFLIES

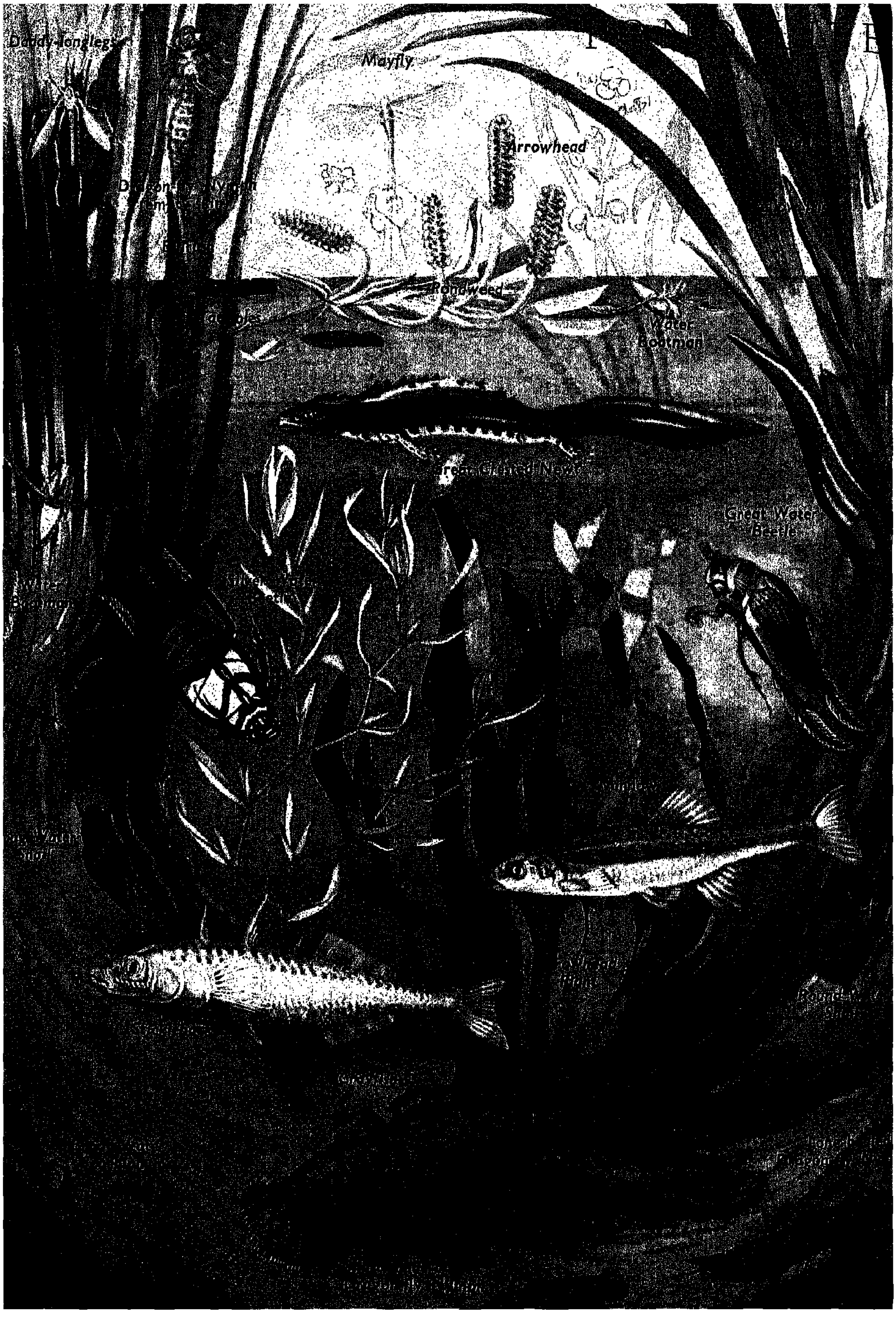

Underside of male Small Blue
Holly Blue
Underside of Green Hairstreak
Ringlet
Underside of White Admiral
Camberwell Beauty
Marbled White
Hedge Brown

CROSS-SECTION



OF A STREAM

Swallow
Moorhen
Arrowhead
Trout
Gudgeon
Fresh-water Mussels


Daddy-longlegs
Mayfly
Arrowhead
Dragon-fly Nymph
Pondweed
Water Boatman
Great Crested Newt
Great Water Beetle
Water Boatman

The story of the pond

A POND IS like an island of water in a sea of land, and the animals which live in it are cut off by land boundaries just as the inhabitants of islands are separated by sea. They all depend on the pond for their lives, and many show most curious forms or strange life-histories which specially fit them for pond life.

A pond may vary from a tiny patch of water scarcely larger than a big puddle—providing it is fairly permanent and does not dry up completely in summer—to an expanse so great that it is dignified by the name of lake or loch. There is never a swift current flowing in a pond, as there may be in a river. Often there is some inflow of water, and you can generally find an outflow, but the plants and animals do not have to cope with the problems of river life, where freely floating forms will be swept away.

The sorts of animals and plants which you are likely to find in a pond will depend partly on the surroundings, including the soil. If you are walking on a high, peaty moorland and find a pond, its clear brown water will be very acid. So it will be unlikely to hold many kinds of animal, and the plants will be of special moorland types. But supposing you live where there are white chalk cliffs and downland, or grey limestone rocks, then the ponds will probably be the home of more sorts of animal than you are ever likely to catch.

If you can see patches of clear sand or mud, with plenty of plants growing in between, as you walk round the edge of the water and peer in, there will most likely be good hunting. But if the pond is densely shaded by trees and has a bottom of dead leaves and rotting twigs, then it is probably a home for but few animals. The depth also is important, for light cannot reach to the bottom through very deep water, and water plants must have some light for growth. So the shallower parts of big lakes will contain more plants, and where there are more plants there will be more animals.

Plants can live without animals, but animals cannot live without plants. Some animals feed on plants directly.

Some will eat other animals, which eat smaller animals, which eat still smaller animals, which eat animals even smaller, and so on. But always the last link in a food-chain of this kind will be a plant-eater. Plants, however, can make the food they need from gases in the water, and from substances which drain into the pond from the land or are formed by decay on the bottom.

The changing seasons affect pond animals and plants as they do those on land, and in winter the life is at its lowest ebb. If you visit a pond in mid-winter you see only dry, brown stems and withered leaves standing up from the cold water or icy surface. Few animals but fish are moving below. The chief interest in winter is often to watch for the visits of different kinds of duck. But it is better to consider a typical pond in the summer.

INHABITANTS OF THE POND

Imagine a fairly large pond, shallow at one end and deeper, with shelving banks, at the other. Rushes and reeds grow along one side from the shallow end, and willows and an alder lean over from the farther bank. One ancient willow has long since fallen over, and its trunk makes a good observation post if you walk along it carefully. The water is clear, and in the sunlight green plants of many kinds can be seen growing up from the bottom. If you approach the pond quietly and sit still and watch you will see what is going on without disturbing the numerous inhabitants.

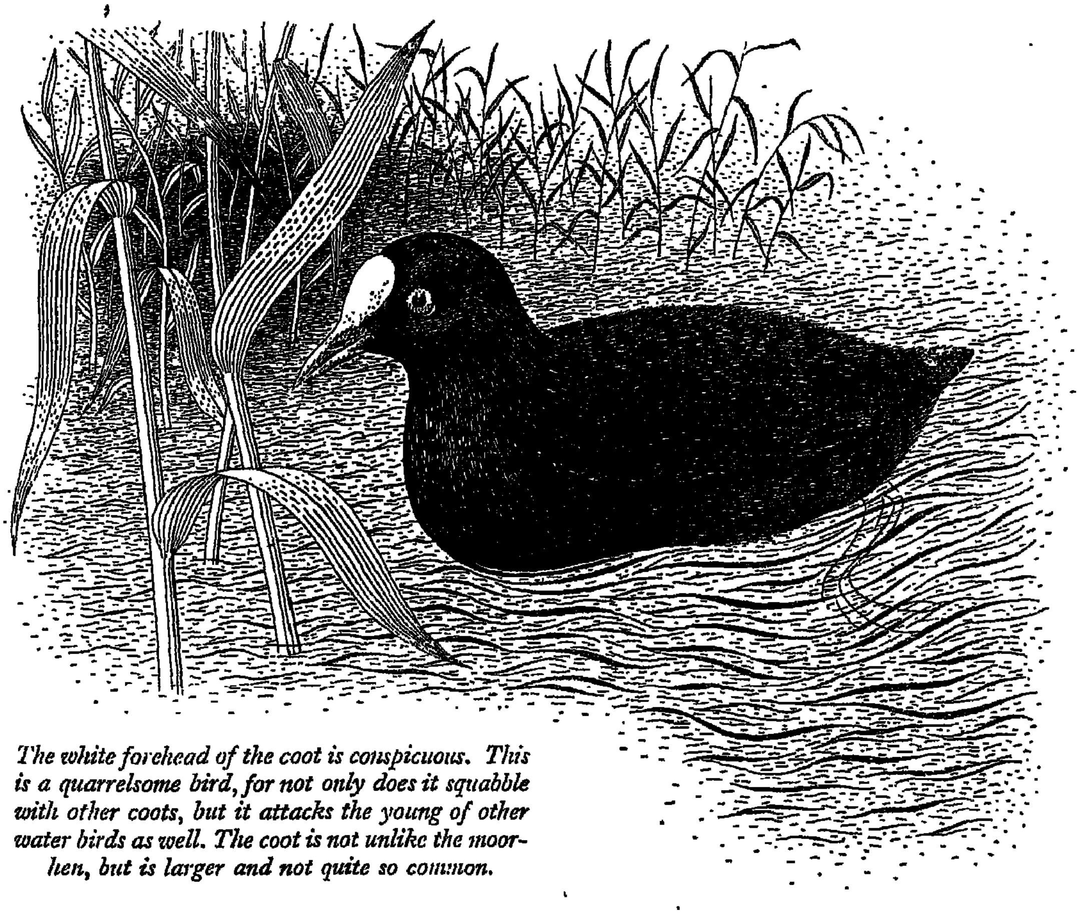
No animals may be visible when you arrive, and the scent of meadowsweet drifts across from the low bank where its creamy-white flowers stand stiffly upright. Beside it are purple hanging clusters of the rough-leaved comfrey. Farther along may stand tall spikes of purple loosestrife, or forget-me-not-blue brook lime and yellow iris.

WATER BIRDS

Birds will probably attract attention first. A harsh metallic call comes from the reed-bed and a moorhen swims out, the bobbing action of its head and neck making it look like a clockwork bird. From its dark-brown plumage the vivid red forehead shows up brightly, and the white feathers under its tail are conspicuous as it turns. It takes off, rather heavily, and its green legs trail along the water as it makes for the reedy ground beyond the pond.

Next a family of mallard or wild duck appears, the little fluffy ducklings following their mother over to a patch of water-lilies. They are too tiny to push the leaves aside as their mother does, so each duckling stands up and walks over every leaf and swims on from its edge. A heavily built, slate-black bird, with a white shield at the base of its beak, hurries across the water, and would attack and peck the ducklings were their mother not prepared to defend them. The coot is always an aggressive bird, but it retires now and turns to diving for food. The mallard has always to be on the look-out for danger to her brood of ducklings; so many enemies, from rats to crows, may pounce on any baby which lags behind or wanders away.

Perhaps no more birds may be seen

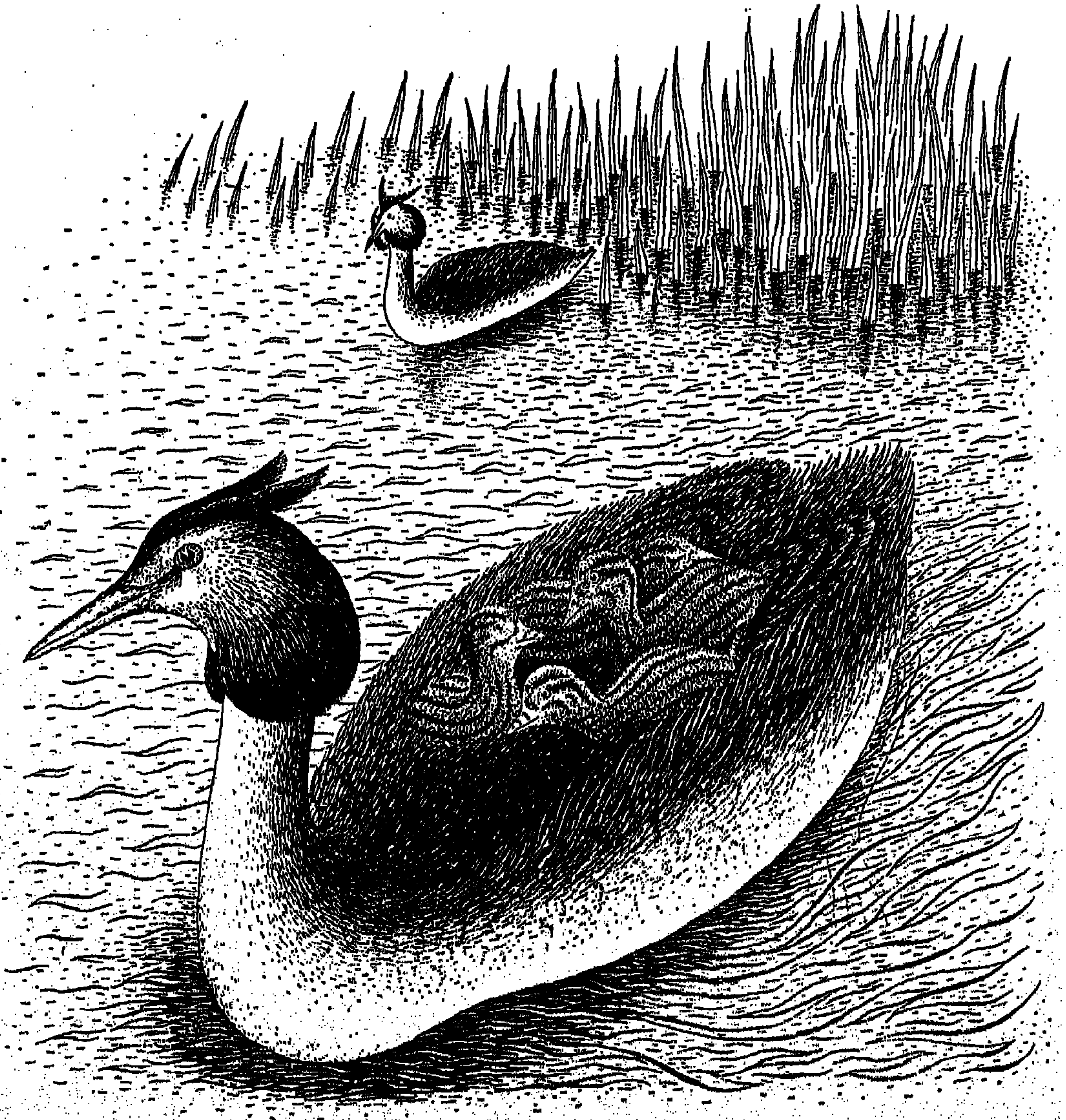


The white forehead of the coot is conspicuous. This is a quarrelsome bird, for not only does it squabble with other coots, but it attacks the young of other water birds as well. The coot is not unlike the moorhen, but is larger and not quite so common.

today, but on other occasions you might see the dabchick or little grebe, a small brown diving bird with a rather tubby little body and a chestnut-coloured throat. It might be necessary to go to a bigger stretch of water to see the dabchick's larger and more exciting cousin, the great crested grebe. Behind its white cheeks a great crested grebe wears a dark tuft of feathers on either side, which stand out like ears. It has dark cheek-frills of feathers, too.

Supposing you were told that these birds had nested and were bringing up their young on a lake, where you could watch, you might go and see the parents swimming round, but no sign of the babies. Then, suddenly, a little head would rise up between the slightly raised wings of one of the parents, and you would realize that the chick had been there, asleep, all the time. It might slither down to the water and show its curiously striped infant plumage. The old birds would dive for food and put it gently into the chick's beak. One chick is often older and larger than the other.

The mute swan is another bird which might visit the pond and perhaps stay to breed. This is the only common swan and, should you find it nesting, be very careful, for swans resent interference. In defence of its mate or young the cob (the cock-bird) may attack, and its powerful wing or beak can deal severe blows. The nest is a great heap of water-plants, and from it the hen-bird, or pen, may hiss defiance at an intruder. The cygnets are grey for their first year, and when young may also be seen having rides on their parents' backs.



During the last few years the great crested grebe has become more common in England and now may be seen on most reservoirs and lakes. It may be recognized by the grey crest which, from a distance, looks like two pointed ears. When swimming the bird may suddenly disappear from view, for it is an excellent diver and spends much time under water searching for small fish and insects. The parent bird sometimes carries its young on its back when in the water. The eggs are a whitish colour and are laid in a nest which consists of a tangle of water-weed and other grasses.

After the duck family and the coot have retired into the reed-bed again, the pond you are watching is quiet. You try to peer in among the reeds, but can see only the velvety, dark-brown bulrushes, the flower-heads of the great reed mace, standing up high above the dense leaves in the centre, and at one side the smaller burr-reed with its zigzag arrangement of flowers like spiky green balls. As you stare over the surface of the water you may suddenly notice a V-shaped ripple moving quickly across it. When this passes near, the long shape of a swimming grass-snake, hunting unwary frogs, can be made out. Only its head is above water, and it swims quite fast, with sideways lashings of its body. This snake may sometimes reach four feet in length, but it is completely harmless to man.

THREE KINDS OF NEWT

Next perhaps you see frequent small breakings of the water-surface—little ripples circle outward—but nothing more is visible. Sometimes this means that fish are rising to take insects at the surface, but this time it is due to a different animal. If you move to a place where you can lean over and look right down into clear, deepish water, you will see a little animal wriggle quickly upward, let out a bubble of air as its nose breaks the surface, turn and dive down again, showing glints of yellow and a long tail. These are newts (or efts), and if you catch a few of them with a net you can examine them in a jar of water.

There are three kinds of newt, and you can see at once if you have caught the big black-crested newt, which is about six inches long, or if you have the little smooth newt or the palmate newt, which are no longer than three inches when full grown. They all come to the pond from their winter resting-places on land round about April, and stay in the water until late May or June. A few may still be found in July. While in the ponds they hunt little animals for food, snapping at small worms and insects when they feel hungry. Each male newt has a fine crest running down its back to the tip of its tail. Out of the water the crest collapses, for it is only a frill of coloured skin, but under water it stands up and waves about in a very decorative manner.

Be very careful if you handle these animals, for no newt has any ribs and its skin is very delicate. The brilliant yellow markings fade and the crest disappears when a newt crawls out to be a land animal again for the rest of the year. Like frogs and toads, they come to water to breed, and just as cock-birds show off their brilliant plumage to their hens in spring, so the cock-newts display their colours and crests before the duller coloured, crestless females.

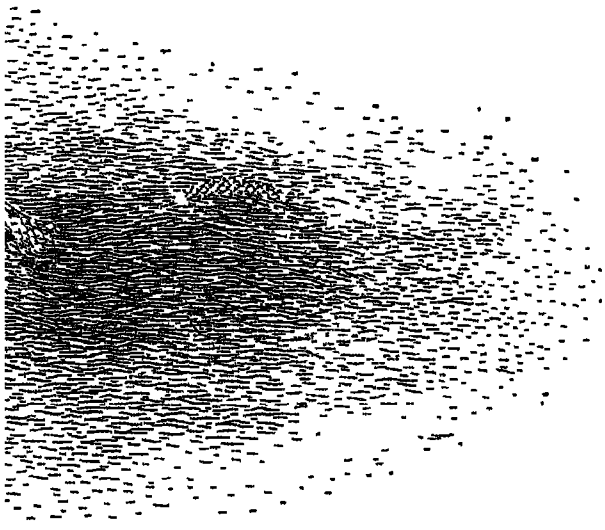
FROG AND TOAD TADPOLES

Occasionally newts will be found with little shells fast shut on one or more of their toes. These are the young of the pond mussel, which fasten on to fish or any other moving object near them, and so get taken far away from their birthplace. Later on they will drop off, and lead their own life on the bottom of the pond, but meanwhile it must be very uncomfortable for the newt.

Both frogs and toads will have left the water earlier. They never stay long, and by now the frogs will be hopping about in the damp grass, while the toads may have travelled far away from any water. But both frog and toad tadpoles will probably be swimming about, often crowding together in hundreds in the sun-warmed, shallow margins of the pond. In a good light you can see that some of these tadpoles are plain black; these will grow into toads. But others, the frog tadpoles, show gold flecks gleaming on their greenish-brown skins.

Though it lives mainly on land, the grass-snake can swim quite well and sometimes can be seen in a pond with its head just above the water as it moves along. Its liking for eating frogs causes it to go near water. The grass-snake gradually becomes too big for its skin and at intervals through its life it grows a new skin underneath and then sheds the old one. You may perhaps see a shiny, transparent, empty skin lying in the grass. During the winter months the grass-snake hibernates, curling up in a hole in the ground or under a pile of brushwood. Although when angry it will dart out its forked tongue, the grass-snake is quite harmless.

Among the weeds tiny newt tadpoles will be swimming, too. They are so different from the fat, dark frog and toad tadpoles that you might not realize they were tadpoles at all until you looked very carefully. Then you would see that although they are fish-shaped and nearly transparent, each is growing two pairs of legs of the most minute size, with tiny toes at their tips. Frogs and toads grow hind legs first because they lose their tails. But you may find newt tadpoles which have only front legs, since in this case these appear first, for the newt will have a long tail all its life.



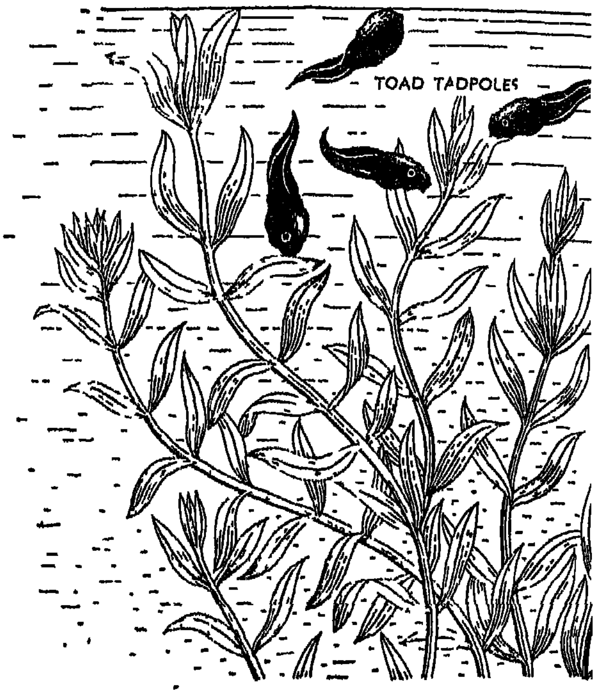
Life must be very full of narrow escapes for a newt tadpole. It need never venture to the surface to breathe, as must its parents, for it has three pink, feathery gills on each side of its throat, by means of which it breathes in the water. Yet its big, copper-coloured eyes must always be on the look-out for enemies, who might swallow it. Sticklebacks and other fish, perhaps large newts, and, most ogre-like of all, some of the big water-insects, will all be seeking, swiftly or stealthily, small creatures like tadpoles for their food. Very few pond animals are vegetarians living on water-weeds. Most of them, even the newt tadpole, spend their time trying to find animals much smaller than themselves to eat, while keeping a constant watch lest they, in turn, should be the victim of a larger animal.

Some of the most lovely pond-insects, and the biggest, are dragon-flies. As the summer passes, more and more kinds of dragon-fly can be seen flying about near water, shimmering in brilliant blue, green, red or yellow, with black or brown markings. While there are several thousand kinds of beetle and fly, there are only about *forty different* British dragon-flies. Watch one of the big blue-and-brown ones as it flies over the pond. It moves at tremendous speed, but can stop abruptly and hover, and change direction in a wonderful way. As it flies near you can hear the dry rustle of its wings. Look carefully at the way it holds its six legs curved round in front of it, because it has arranged them to make a basket and it puts midges and little flies into this basket as they are caught. The midges do not fall out, because stiff bristles stick out from the dragon-fly's legs to fill up the gaps. When it has enough, the dragon-fly alights to eat its catch. If it catches a blue-bottle or other big insect, it settles down at once, maybe on a person's arm or leg. If this happens to you, try to make out the dragon-fly's face, which has a pair of shining eyes, so big that they meet on top of its head.

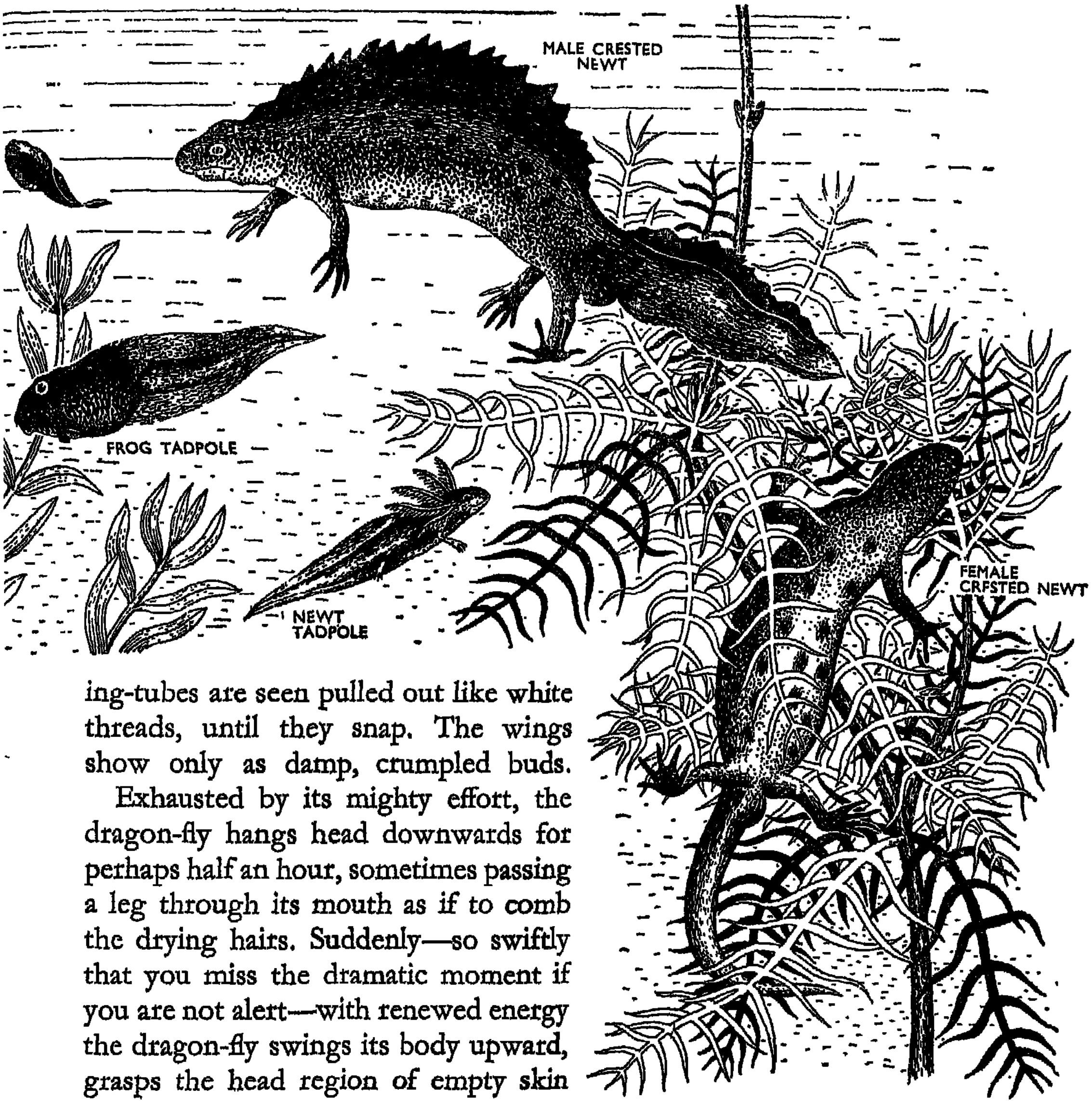
Sometimes you see a dragon-fly hovering over a pond surface, just touching the water at intervals. This is the female laying her eggs. When an egg hatches, a little creature crawls out which has not the faintest likeness to a dragon-fly. Baby kittens, foals, rabbits or humans all look something like their parents, but a baby insect is so different that it has to have a separate name, and is called the larva of the particular insect. A dragon-fly larva is a fierce little beast from the first, even at one-tenth of an inch long. It crawls about on the pond bottom, catching and eating still tinier animals. Soon it grows too big for its skin, which splits to release it, and the larva wriggles out, swelling to nearly twice its former size.

So it goes on all the summer catching food, growing until it bursts its skin and suddenly coming out a larger size. In winter there is little food about and it rests; but in spring it starts hunting again, and is full grown at about two inches. Tadpoles are now its chief food, and some people find it quite frightening to watch the larva creeping up to an unsuspecting tadpole. Suddenly, after a movement so swift that you cannot see what is happening, the tadpole is in the larva's jaws. The dragon-fly larva wears an extraordinary mask over its mouth. This is like a pair of pincers on a long arm, which can be shot out to grasp its prey and bring it back to the real mouth.

Soon the larva stops feeding, and after a few days crawls up a plant stem until it is quite clear of the water. This you can watch for yourself if you keep



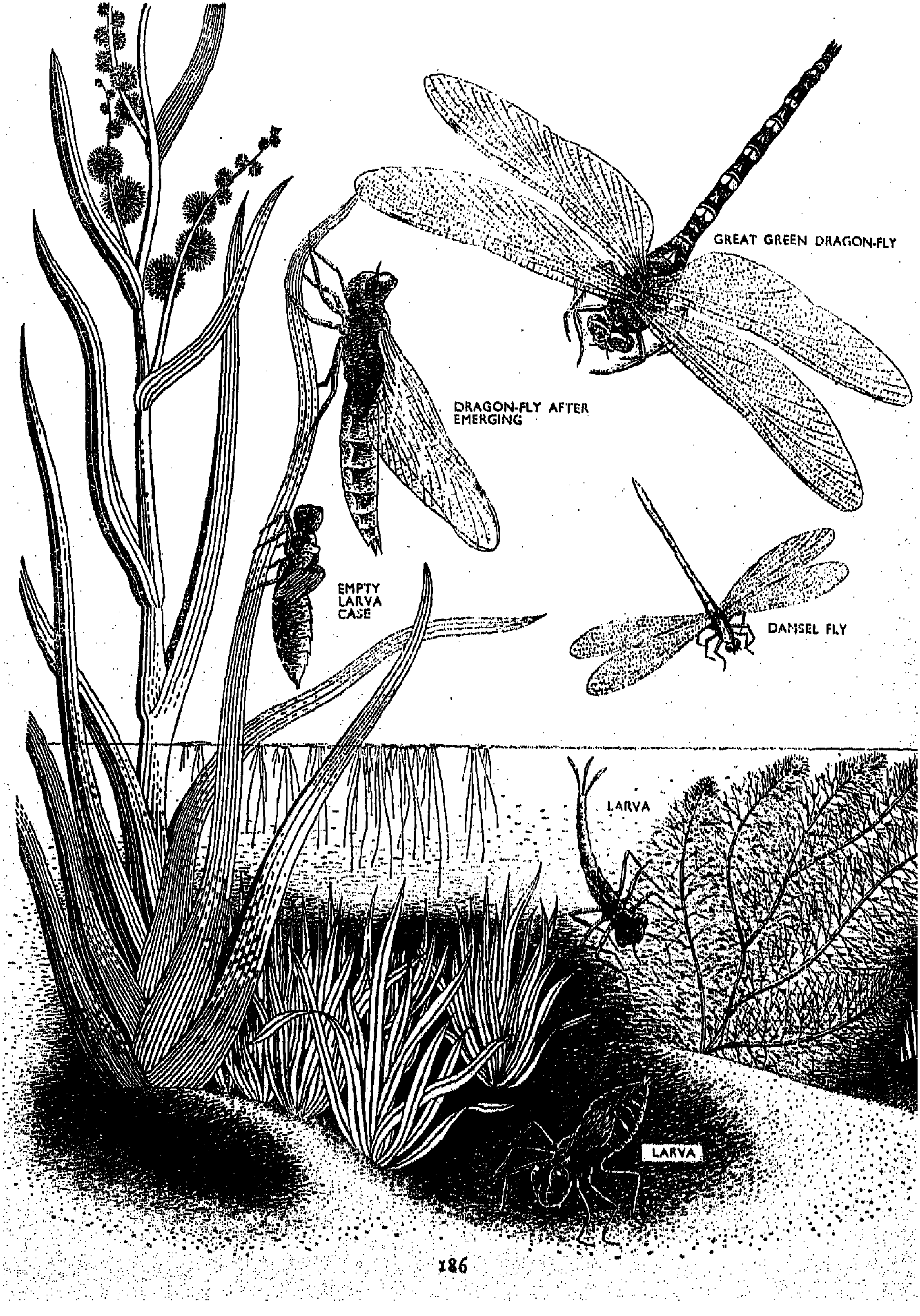
some in an aquarium, and it is one of the loveliest transformation scenes in all Nature. The ugly little larva gradually dries and adjusts its feet until it has a firm grip. It remains quiet for a few minutes and does not look alive at all. The dragon-fly inside is separating itself completely from the larval skin. Then it is ready to come out, and you can see swelling, pushing movements from within as the dragon-fly tries to free itself from what is now only an imprisoning skin. The movements grow more violent until suddenly the brown skin splits behind the head and the dragon-fly itself begins to push its palest green, soft body through the hole. The slit widens, the dragon-fly's head with great shining eyes comes out, and it gradually leans backward as it draws each pair of delicate legs from their sheaths. Even the linings of its breath-



ing-tubes are seen pulled out like white threads, until they snap. The wings show only as damp, crumpled buds.

Exhausted by its mighty effort, the dragon-fly hangs head downwards for perhaps half an hour, sometimes passing a leg through its mouth as if to comb the drying hairs. Suddenly—so swiftly that you miss the dramatic moment if you are not alert—with renewed energy the dragon-fly swings its body upward, grasps the head region of empty skin and curves its body free. Then, in just a few minutes, you can watch the wing-buds spreading out, their crumples disappearing, until shimmering, transparent wings reach down beyond the tip of the body. The insect now rests for some hours before it is ready for flight. Often the dragon-flies emerge from the larvæ in the evening and fly the next morning.

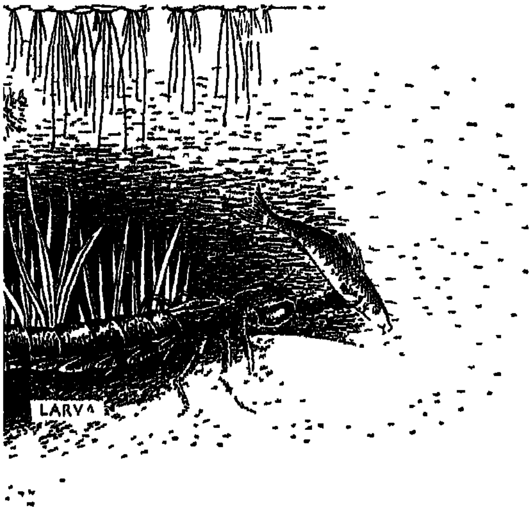
Frogs, toads, and newts all start life as eggs which are laid in water and develop into tadpoles. The tadpole of the toad (TOP LEFT) *is black, that of the frog* (CENTRE) *dark brown and speckled with yellow spots, while the newt tadpole* (BOTTOM CENTRE) *has feathery gills. On the right is shown the male crested newt with the female below it. All these animals may be found in freshwater ponds and lakes, but as a rule frogs and toads do not inhabit the same water.*


GREAT GREEN DRAGON-FLY
DRAGON-FLY AFTER EMERGING
EMPTY LARVA CASE
DAMSEL FLY
LARVA
LARVA

The dragon-fly may live for some weeks, and it certainly is very useful to man on account of the large number of gnats and flies which it destroys. Some people think that dragon-flies sting, but they cannot, and are quite harmless.

There are many kinds of smaller dragon-fly whose bodies are azure, crimson, blue-and-black banded, or black with a powder-blue tail. These have a habit of clinging to a reed and sidling around it, keeping the stem between themselves and you, and peering round at you with their large eyes. They can turn their heads so far sideways that you almost wonder if they can swivel completely round. Their larvæ are more delicate, and have three leaf-like gills growing out from the tail.

Besides the type of pond which has been described, you will be able to find quite different kinds, and round their margins and in their waters will be growing new plants. Some of these plants, such as burr marigold, which has hooked fruits which cling to your clothes or to an animal's fur, like to live in damp ground only. On moorland, warning is often given of a boggy place by the fluffy white tufts of cotton grass waving about it.



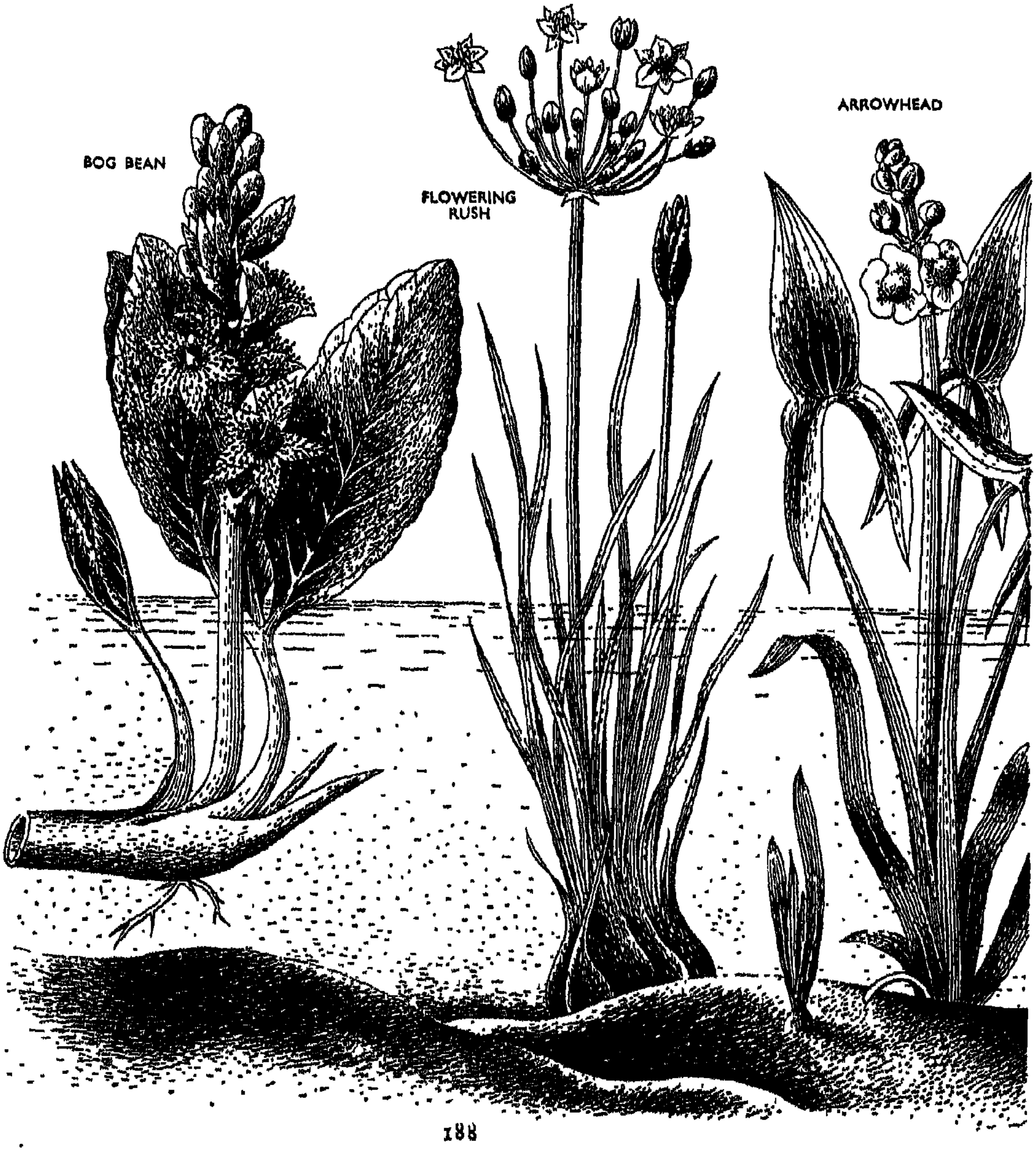
Larvæ of both the dragon-fly and the damsel fly live in ponds and feed on water animals. One of the dragon-fly larvæ (BOTTOM RIGHT) *is shown catching a small fish*

Other plants grow well in the water, but send their leaves and flowers high above it. One of the loveliest of these is the May-flowering bog bean or buckbean, easy to recognize by the three leaflets which make up each leaf, and the spike of delicate, palest pink and white flowers. These may cover the whole of a shallow Scottish loch. The flowering rush bears a group of beautiful pink flowers on a three- or four-foot stem, high above the water. Arrowhead is another fairly common but attractive tall water-plant. Its name comes from the leaf shape, and the flower-spike bears large, three-petalled white flowers, in groups of three.

Many water-plants have two kinds of leaf, one which remains below water and the other type which grows above, or floats on the surface. The water crowfoot, whose flowers, rather like white buttercups, may cover nearly the whole of a pond in early summer, shows its close relationship to buttercups also in the above-water leaves. But it has a quite different kind of leaf while it is still growing under water, leaves which are finely divided in numerous thread-like strands. These let the water flow easily between them.

The pondweed family have inconspicuous flowers, but the oval, leathery floating leaves of the oblong pondweed are often conspicuous, and the submerged, crinkly leaves of the curly pondweed are easily recognized, since they look as if they had been permanently waved.

It is always lovely to see water-lilies in flower. The thick stems of the big, round, tough leaves can be seen rising up from some central point in the depths of the pond. The rounded flower-buds open into the crisp, pointed petals of the white water-lily, or the rather smaller flowers of the yellow water-lily. Some plants, rooted in the pond bottom, never send leaves above the surface, although they may have inconspicuous little flowers, with no petals, which rise up a



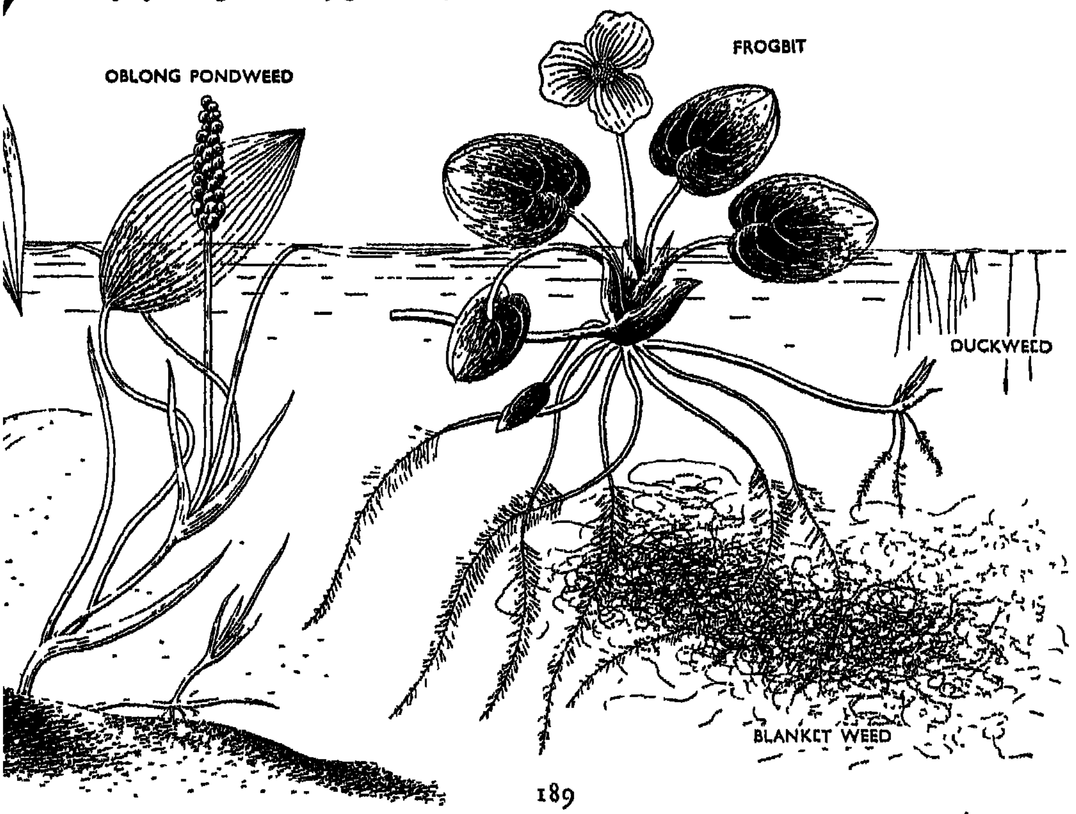
few inches. One of the most common water-plants all over Britain is the Canadian pondweed, which was introduced about a hundred years ago from Canada by mistake, and has spread everywhere. Any little broken-off fragment can go on growing, which makes it useful in an aquarium but a great nuisance in canals and reservoirs. The small, bright-green leaves are arranged in pairs on the stems, which may form a dense growth.

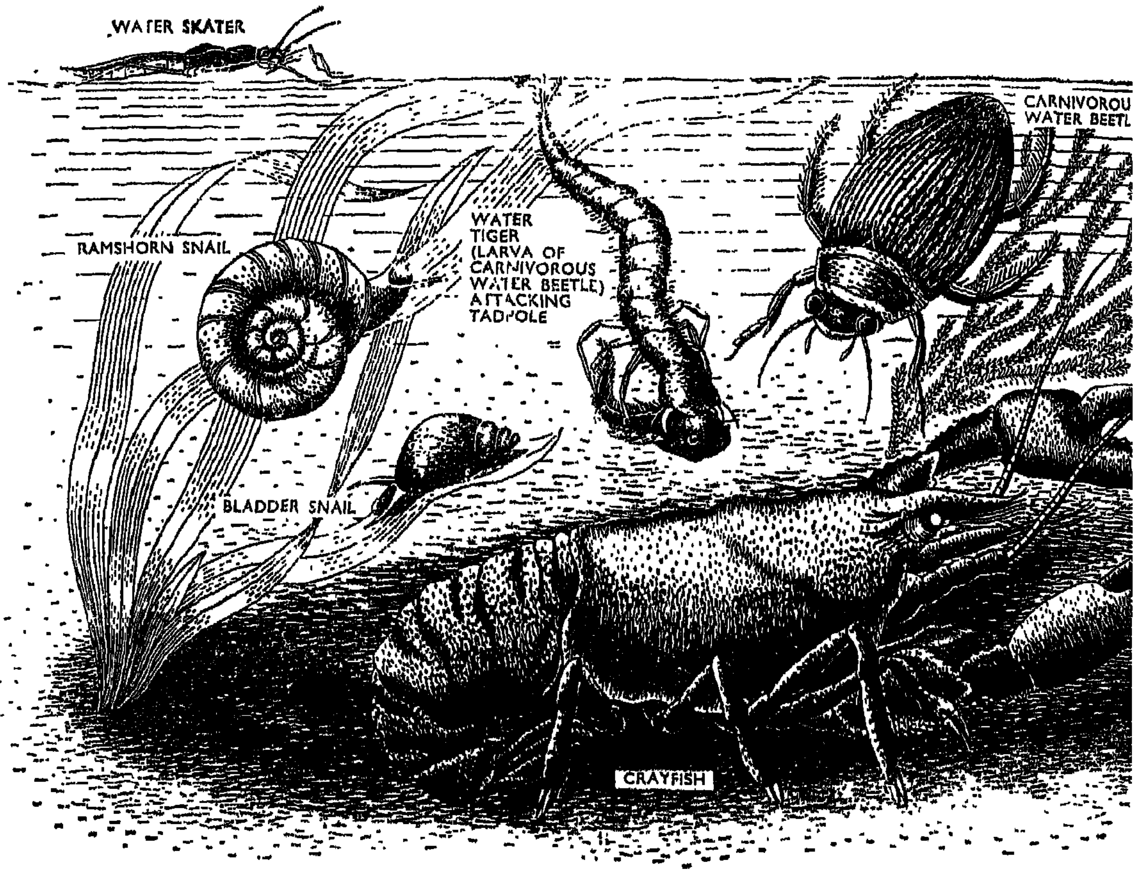
The rarer and more attractive frogbit also floats. It has winter buds which sink and rest in the mud during winter, and float up and grow into new plants in spring, bearing spikes of three-petalled white flowers.

You will almost certainly have noticed one kind of water-plant of a pale but bright green which grows so densely on the surface that it forms a complete carpet. Unwary puppies, and sometimes children, try to walk on it, only to find the solid-looking carpet drifts away under their feet.

Duck-weeds are the plants which grow in this way. If you float a little in a jam-jar you will make out the tiny, flat, green plants, each with several minute roots hanging down into the water. There are several kinds, with different sized or shaped leaves. Duck-weeds remain on the surface, but there are many

Many plants which live in fresh water set their roots in soft mud under the surface, but send their flowers and leaves above the water. On the left in the drawing, four common plants of this kind are shown. On the right are seen the floating weeds—frogbit, duck-weed and flannel-weed, or blanket-weed as it is sometimes called, which consists merely of a tangled mass of green slimy threads.





None of the pond creatures shown here has a backbone: instead they all have skeletons outside their bodies. The two snails on the left in the picture have large, heavy shells, and the other animals which have a flexible, jointed armour all over their bodies are all insects except the crayfish. This animal is also found in streams and is closely related to the lobster and the prawn.

kinds of minute, thread-like green plants which float below water and may form such great masses that they are known as flannel-weed. This sometimes has to be cleared out from a pond in great loads. Other green "pond scums" are made up of tiny floating plants, often so small that individual plants can be seen only under a microscope. Then a shapeless, greenish blob may be seen to be made up of hundreds of one-celled plants, each with a quite definite and often pretty shape. Pond-water which appears almost clear may be found to contain microscopic plants of amazingly beautiful shapes and patterns. Although so small, these may increase to such huge numbers that they form important food supplies for other pond animals.

Several kinds of fish live in ponds, and of these sticklebacks are the most common in many districts, though they may be known by other names. The biggest are only three inches long, but their readiness to challenge any who pass their way makes one feel that, in their own opinion, they are very important fish. Sticklebacks get their name from the fact that curved spines or stickles stand up on their backs in front of the

back fin. There are more spines sticking out from the underside, so that the little fish bears good weapons. In summer it is as easy to distinguish the cock- from the hen-fish by colours as it is to tell the difference between a farmyard cock and hen. In the breeding season the cock-fish becomes a brilliant sight. His throat is crimson, his back shining green, his sides silver and his eyes blue. The hen-fish remains silver, darker above and lighter below.

The stickleback's behaviour at this time is also unlike that of most fish, for the cock-fish not only builds a nest, but proves himself a most devoted father. He chooses a small area of the pond for his own, and defends it against all intruding fish. The stickleback then picks up strands of water-weeds with his mouth, and forms them into a little, muff-shaped nest, sticking them firmly together. He persuades a hen stickleback to lay some eggs in his nest, but later drives her away. Not content with these, other hen-fish are enticed in, to add more eggs, until fifty or sixty may be heaped together in the nest. The stickleback then hovers near his nest and guards it. He will dash out and attack any passing fish.

Often it is possible to find a nest by watching the behaviour of fish in clear water, and noticing which seems to remain in the same place, darting out to drive other fish away, but returning each time to his station. Sometimes the stickleback will fan the eggs with his fins to prevent mud from settling.

After two to four weeks the infant fish hatch, but still the stickleback's watch continues. His work is harder, for he finds some of the food for the babies, and if these minute fry venture out from the nest their father may suck them up with wide-open mouth and shoot them back into safety. At last the young fish swim off independently and the parent stickleback's responsibilities are ended. But some of these cock-fish are probably killed during the nesting time, for their aggressiveness makes them so conspicuous. Yet many a big fish has tried to swallow a stickleback, only to find the raised spines all along its back sticking in its throat.

Besides dragon-flies and annoying flies and midges, other pond insects are bound sooner or later to attract your attention. Some of these live the whole of their lives in the pond. Others, like the dragon-fly, change into winged forms which can fly far away. All of them lay their eggs on or below the surface of the pond, and the egg-clusters can often be found on the stems or under the surface of leaves of water-plants.

A BEETLE WHICH STORES AIR

Each egg hatches into the larva of the particular insect which laid the egg. Like the young dragon-fly, these larval beetles or mayflies or other forms all spend their lives feeding and growing, and then moulting their skins. This is repeated again and again. But not all the full-grown larvæ climb out and split to release a winged insect. If we follow the life-cycle of a water-beetle we shall find it has an extra resting stage, like the chrysalis of a butterfly.

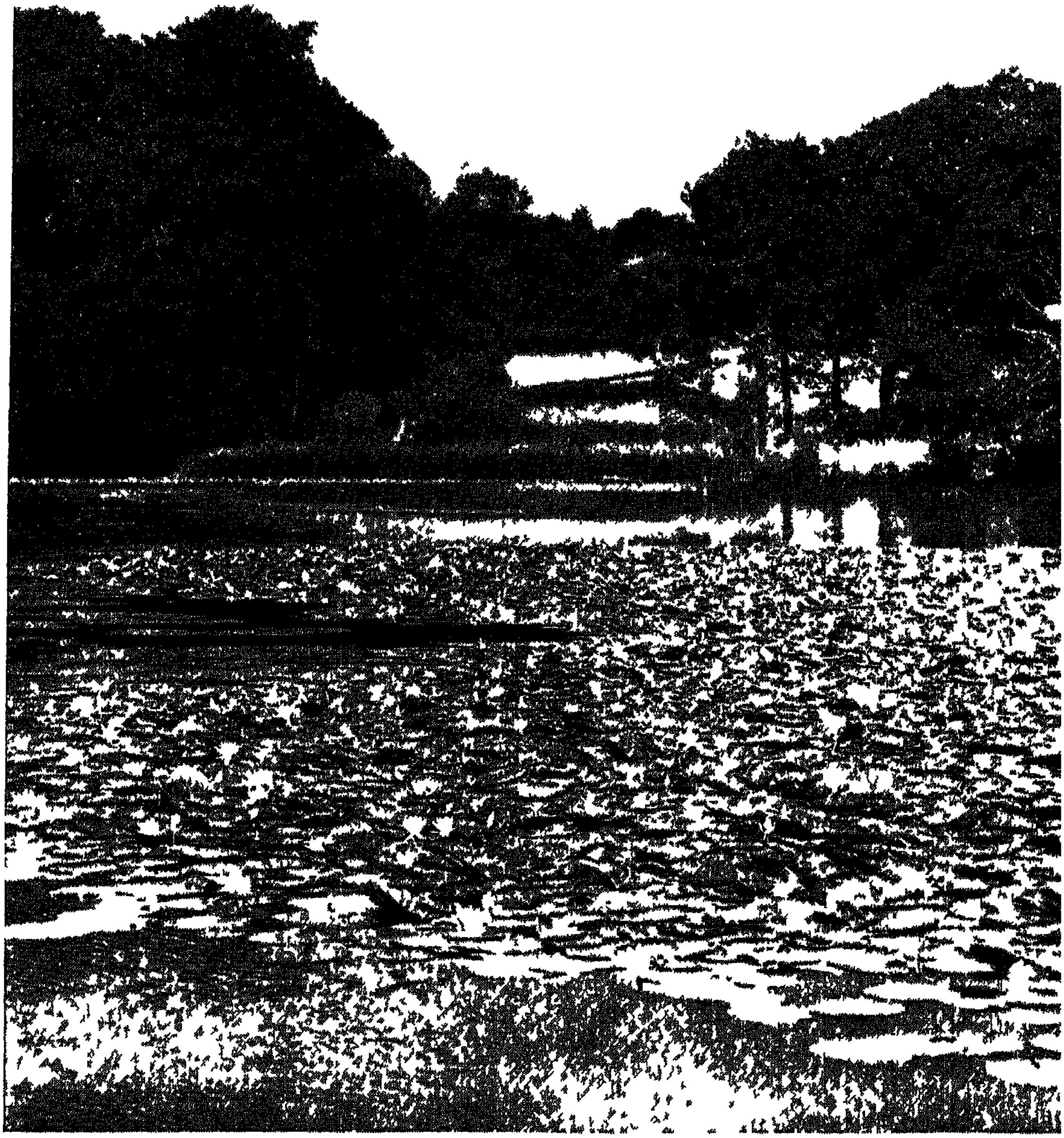
As you look into a pond you will often see a beetle float up to the surface, stick out its tail for half a minute, and then swim down again. When its tail comes out it breathes, taking down a reserve store of air under its curved wing-covers. Water-beetles can fly, and often climb out of the water and take off, especially at night.

The great water-beetle, whose name is Dytiscus, is the most common large pond-beetle. It is more than an inch long, olive-brown in colour, with yellowish margins. This beetle eats animal food, even attacking fish and newts, but it is mild in nature compared with its larva, which has earned its name of the tiger of the pond. It is well to learn to recognize a Dytiscus larva, if only to be certain that you put with it no other animal which you want to remain alive. When full grown it is a yellowish-brown, two-and-a-half-inch grub, with a flat head and curious kink in its back, so that its shape reminds one of the position of a man standing on his hands. With its six legs, it paddles along in this odd posture or else swims with violent rocking movements of the whole body. This ferocious larva will tackle, kill and suck nearly any pond creature, even fish bigger than itself. When at last full fed, it burrows into the pond-bank and makes a little cell for itself in the earth, above water-level. There it rests until it moults and becomes a white pupa. From this pupa the beetle emerges after several weeks and makes it way back to the water.

HOUSE-BUILDING INSECTS

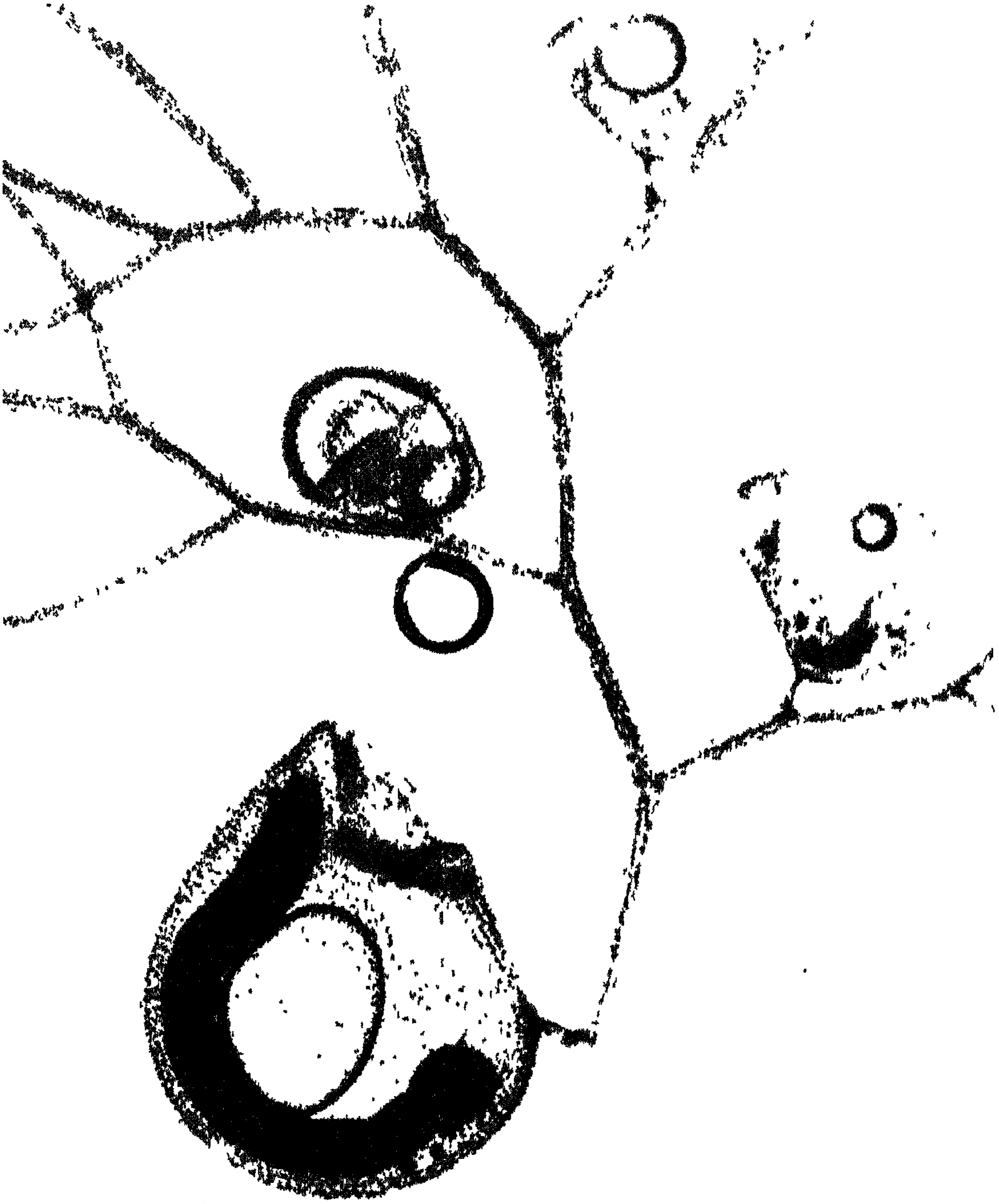
If you peer down through clear water at a sandy patch you will often see, apparently, tiny groups of sticks walking about. But on picking up one of the stick clusters you will find that a caterpillar-like little animal has built itself a portable house. This is one of the caddis-worms, which turn into many kinds of moth-like flies seen hovering over the water or laying eggs on the surface. Each little egg group is surrounded with jelly which swells in the water.

When the minute caddis-worm hatches it at once begins to build a house. If its ancestors used sand only, it uses sand only; if they used leaves, it uses



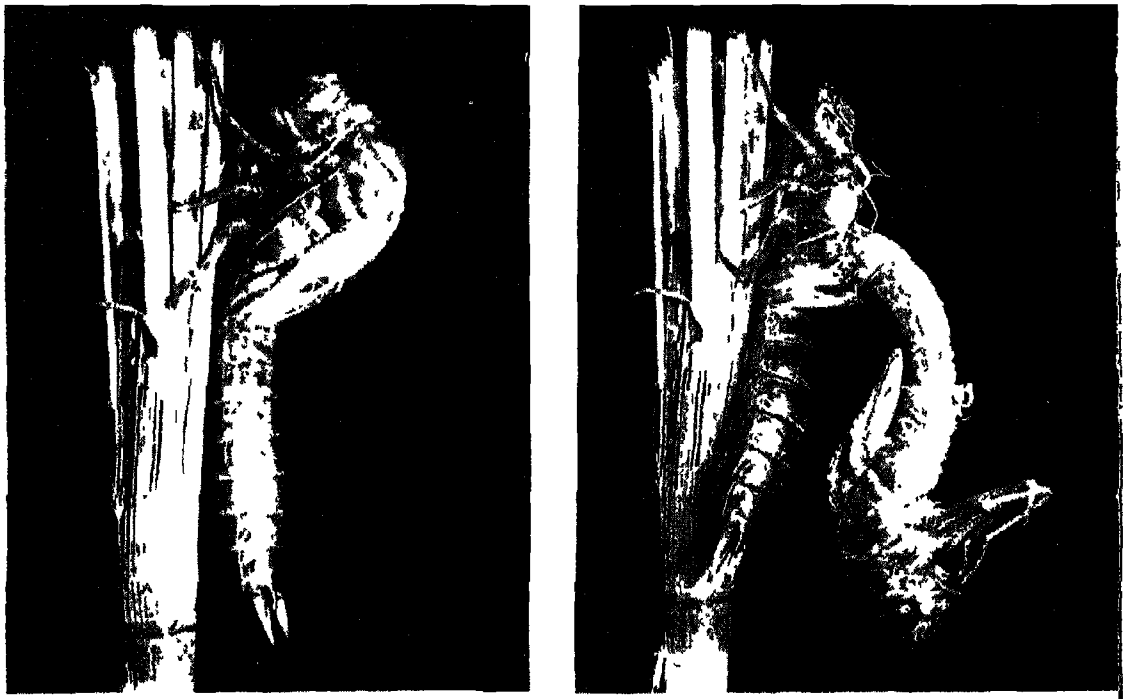
THE POND

All the many types of plant and animal found in the pond are specially suited to this kind of life For example, water-lilies have breathing pores on the upper sides of the leaves instead of on the lower, as is usual with other plants The sedges have large airpockets in their leaves, so that even if they become completely submerged they have an air supply that enables the plant to breathe. Although the pond on this summer day looks so calm and peaceful, grim battles are taking place there because many of the creatures in it live by eating some of the others.



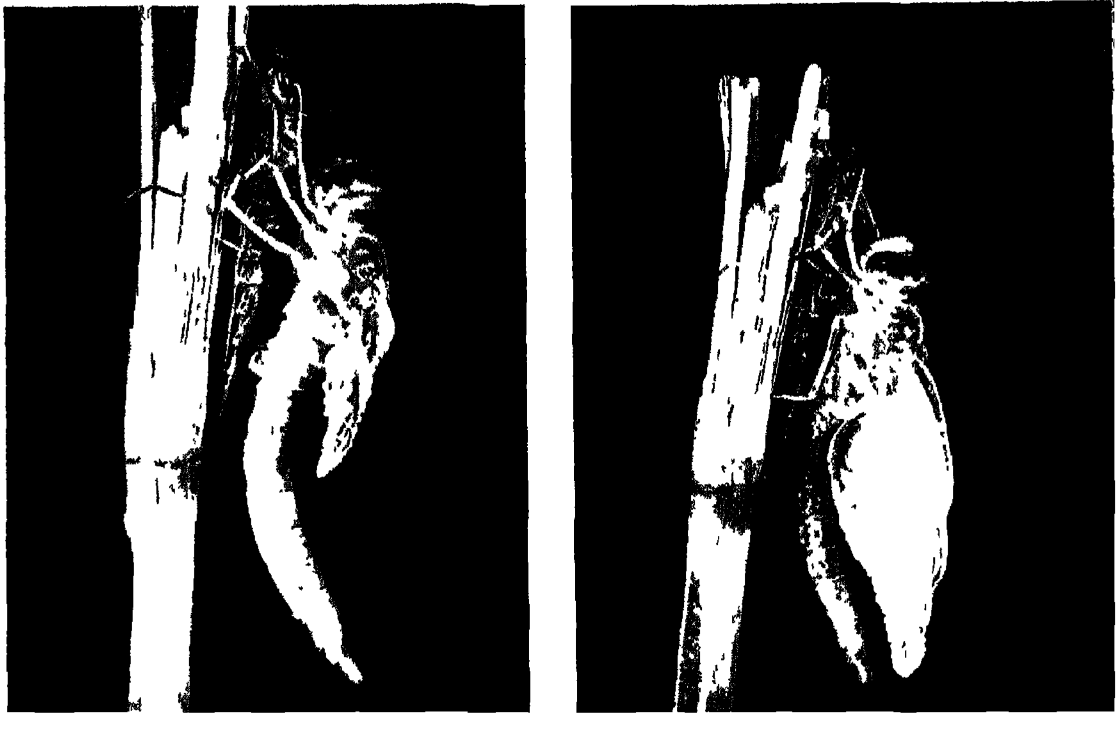
A PLANT WHICH EATS ANIMALS

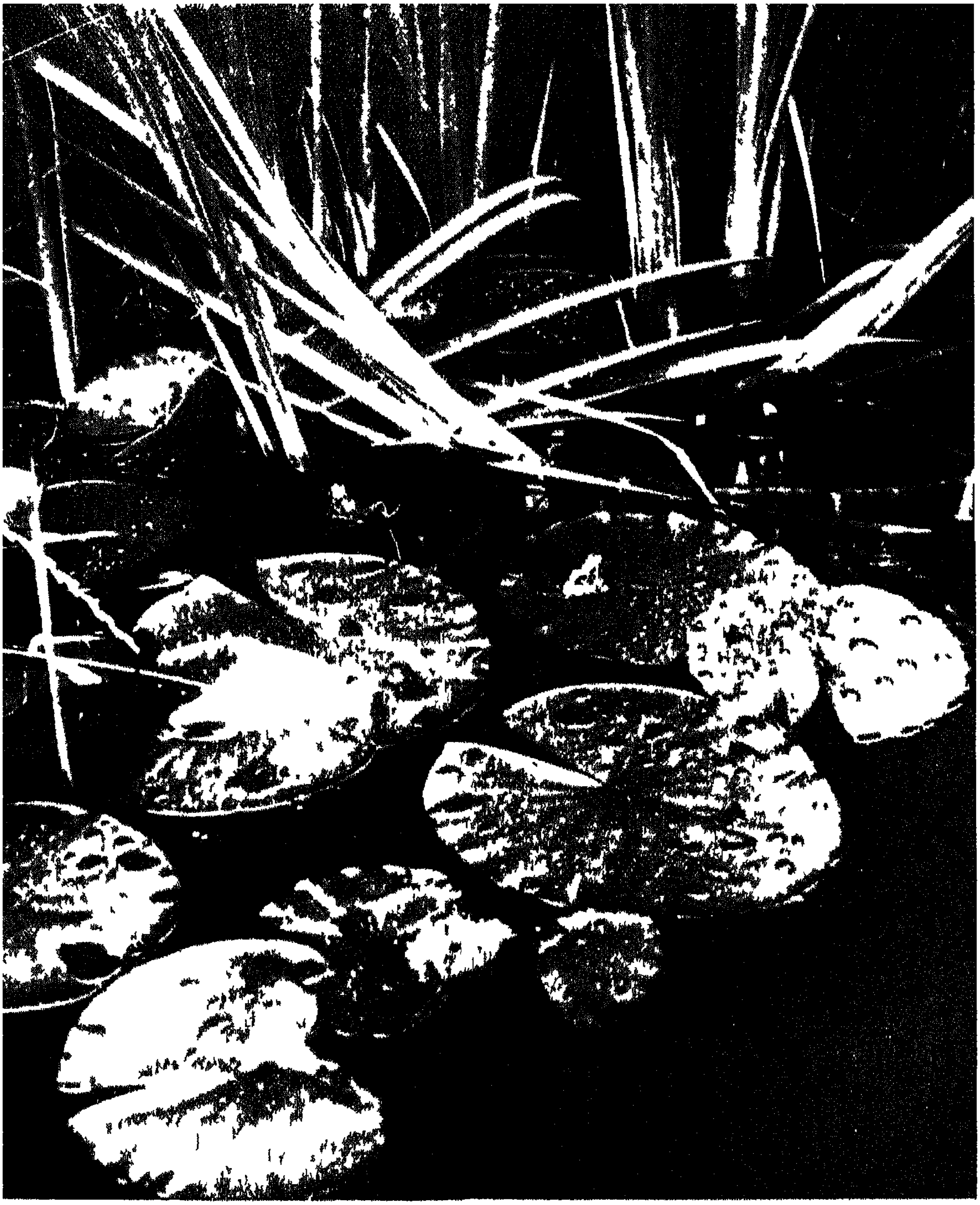
Bladder-wort has slender, delicate green stems which bear branching, thread-like leaves. Its stems and leaves contain chlorophyll, so that the plant can make food in the same way as other plants, but, in addition, the bladder-wort eats animals. On its leaves below water there are air-filled bladders, each of which has a trap-door which opens easily if pushed against by small water animals, but is kept closed by pressure when the bladder has been filled with water containing the little animal. So the animal is imprisoned, killed, digested and absorbed by the plant. In this photograph a small caterpillar, which fell into the water from an overhanging tree, is shown (bottom left) *imprisoned in a bladder.*



THE DRAGON-FLY EMERGES

Hatching from eggs laid in a split in the stem of a water-weed, the young of the dragon-fly is called a nymph. For a year it lives in the pond, then, in the summer, crawls out of the water up the stem of a water-plant. After it has rested, a split occurs along its back and out come the head and middle of the adult dragon-fly (top left). *After again resting it bends sharply back and hangs head downward* (top right) *to free all but the tip of its tail. Again it rests, then flicks its body upward, freeing itself completely. It cannot yet fly because the wings, having been packed within the nymph skin, are soft and crumpled* (bottom left). *They gradually expand and dry* (bottom right).





FROGS AMONG BULRUSHES

Among the bulrushes and water-lilies of the pond live small frogs. Those shown have not long changed from tadpoles, which hatch from the masses of frog spawn laid in the spring. During spring and summer months the tadpoles are unable to live out of water and they feed on water-weed. Then they lose their tails and grow legs. In this way they change into frogs. They cannot then eat water-weed, but feed on insects and small animals. Frogs are usually found in damp places, except in winter, when they hibernate. They come out again in the spring and in huge hopping armies make their way to the ponds and rivers.

leaves; just as a chaffinch or tit makes a nest typical of its kind. The caddis has a delicate body, and each of the many types of house is silken smooth within, however rough on the outside.

Some caddises bite off rectangular bits of weed and stick them together with the utmost regularity, until they form a perfect spiral case, broader at the head end as the caddis grows. It keeps the house in position by hooks on its tail, and only puts its armoured head and legs out in front. Some caddises attach sticks and stems three or four inches long to little sand houses, and others make their homes of tiny pieces of stick arranged criss-cross, each stuck firmly on before the next is grasped. You may even find cases with minute shells fastened all over them. It is interesting to make a collection of different types of empty shells.

Many caddises are general scavengers, eating a variety of things. When the caddis-worm is full grown it spins a grating of silk across the opening of its house and turns into a resting pupa. After some days the pupa bites through the grating and swims to the surface and crawls out. Almost at once its skin splits, and the caddis-fly emerges and dries its wings before flying off.

ANIMALS WHICH WALK ON WATER

Water-boatmen are often conspicuous pond animals. Their name comes from the way in which they row along, using their very long, hair-fringed, third pair of legs as oars. They swim on their backs, and they, too, can fly. They are related to the diamond-shaped and curiously flattened water-scorpions, and also to the pond skaters. Numbers of different kinds of these can often be seen, darting about with widespread legs on the water surface, but never breaking through the surface film. This surface film can support the weight of many small animals, just as it will support and float a needle if you lay one down carefully on water. It is as real a boundary to small animals as a hedge or wall is to human beings. Snails and flatworms can be seen crawling on the underside of the surface film, just as the pond skaters move about it.

WATER CATERPILLARS

All the pond animals which breathe air have to break through the surface film each time they take in air, but many insect larvæ and some other creatures have gills rather like those of fish. These animals need never come to the surface, but use the oxygen in the water.

If you examine floating water-lily or oblong pondweed leaves you will often see places where a piece has been cleanly bitten out, usually oval in shape. If you turn up some of the leaves the cut-out pieces may be traced, two of them fastened together to the under side of a leaf by silk, forming a little waterproof tent. This is made by one of the few water caterpillars—that of the China-mark moth.

Hundreds of other kinds of insect larvæ or adult insects, of which we can mention only a few, are creeping over the bottom, swimming about or climbing among the water-plants. There are many types of gnat and mosquito, and in stagnant pools the little three-quarter-inch wriggling larvæ occur often in hundreds, hanging head down from the surface film. With them are the active pupæ, whose big heads are sheaths containing the future gnat's long curled-up legs and wings. Emergence is a critical moment for a gnat; it has to pull its leggy little body free from the most fragile boat of its discarded skin. A breath of wind may mean capsize and death.

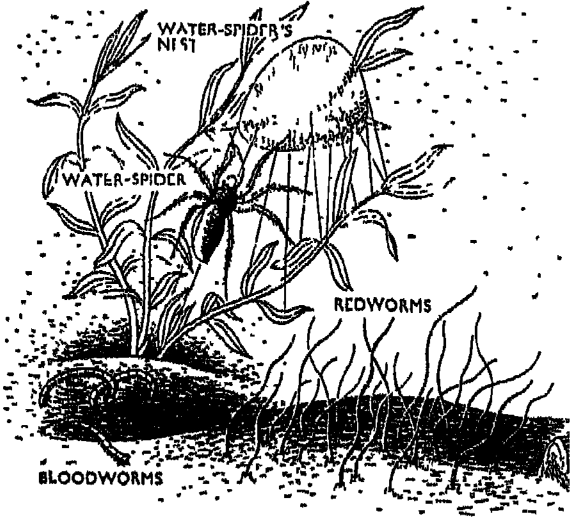
Besides insects there are in ponds many other animals without backbones. In Britain there are no freshwater crabs, and the small, lobster-like crayfish is becoming rare except in a few places. But there are innumerable little freshwater shrimps which, when disturbed, swim frantically on their sides until they can get into hiding again. Smaller still, and far more numerous, are the varieties of water-fleas (no relation of fleas) which are important as a food supply for larger animals. One of the biggest is daphnia, often bred to supply aquarium animals.

Freshwater worms are never very large. Some kinds burrow in the mud and wave their ends about at its surface. Others rest under stones or crawl along. The biggest are the leeches, which cling by a sucker at each end to stones or to other animals from which they suck blood. Unlike some foreign leeches, these are not dangerous to people. There are no British pond animals of which anyone need be frightened.

Few kinds of spider live in water, but the water-spider has a wonderful method of providing air for itself to breathe under water. It spins a thimble-shaped, silken net, firmly held by strands at the edges, and carrying down bubbles of air, releases them below the net. In this way it forms an air-balloon in which it can lurk. Small relations of spiders, little brilliant scarlet or dull-grey mites, with eight legs, may often be seen waving their legs violently to propel themselves through the water.

In most ponds some water-snails can be seen crawling about on the plants and coming up to the surface to breathe. In aquariums you can watch them floating up at intervals and hear the pop as the breathing hole opens above water. When the snail has taken in a store of air it crawls down a plant, holding on very firmly with its foot, because it is so full of air that it would rise to the surface again if it let go. Some of the snails have tapering shells; others, like the big ramshorn, have a flat coil and are called trumpet snails. Besides the coiled snails there are little pond limpets clinging to stones or below floating leaves, and in the mud or sand live pond mussels. These plough their way slowly along the pond bottom. Some have six-inch shells.

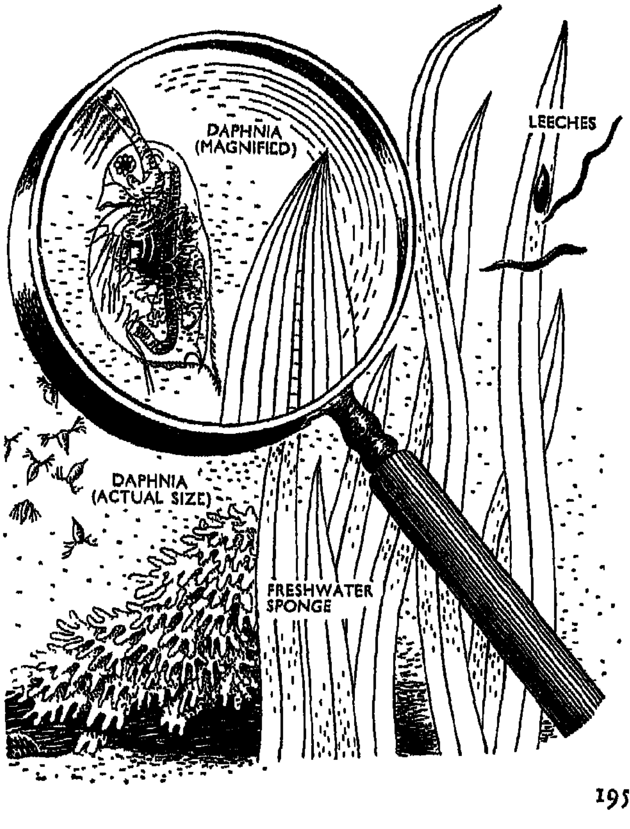
In a few ponds a green growth, which



you might think was some kind of plant, spreads over part of a bank, or forms a layer over sticks or stones below water. This is a freshwater sponge, related to the animal which makes a bath sponge. You will not be able to make out any form in this sponge, but can easily recognize it if you pull up a piece, for it has a most peculiar smell.

The more closely you hunt about in a pond, pulling out weeds and seeing what is moving about on them, the more animals you will find. If you strain the water among pondweeds again and again through a net, and then wash the net gently into a dish or jar of water, you will often find you have caught hundreds and hundreds of little animals which you never suspected were there. When you have gazed into the jar and picked out the tiniest speck you can see jerking about and showing it is alive, remember that there are hundreds and thousands still tinier.

In a pond there is a whole world of minute animals breathing, feeding, producing young, and carrying on the necessities of their brief lives. Because many can properly be studied only with the aid of magnifying glass or microscope, it is often convenient to have a small aquarium which can be a pond in miniature and in which animals such as those shown in the drawing below can be kept.



There are always fresh things to be noticed in a pond, but often particular animals and their life-histories can be watched far better in aquariums. An aquarium may be any water-container, from a jam-jar to an expensive, metal-bound, plate-glass tank.

Whatever the vessel, the first step in setting it up as an aquarium is to wash and rinse it thoroughly, to make sure that no poisonous substance is present which might dissolve and harm the future inhabitants. Then the vessel needs to be made as much like the water animals' natural home as possible. Some sand or fine gravel can be put in to form a layer at the bottom. Sea-sand should not be used except for a salt-water aquarium. A few larger stones should be chosen and arranged to form caverns, in which animals of a retiring nature may hide. The aquarium is then filled with water and allowed to settle.

Water-plants may be put in next. Canadian pondweed, water starwort, water-crowfoot, curled pondweed and water-milfoil are some of the plants which grow well in aquariums. Canadian pondweed is of particular value, as it gives off numerous oxygen bubbles in sunlight. You need not try to get whole plants of these water-weeds; any little spray will grow. If you can get a small piece of sheet lead, cut off narrow inch-long strips, and fold one round the base of each tuft of weed. Then the weighted spray will sink, and the lead can be gently pushed below the sand or gravel.

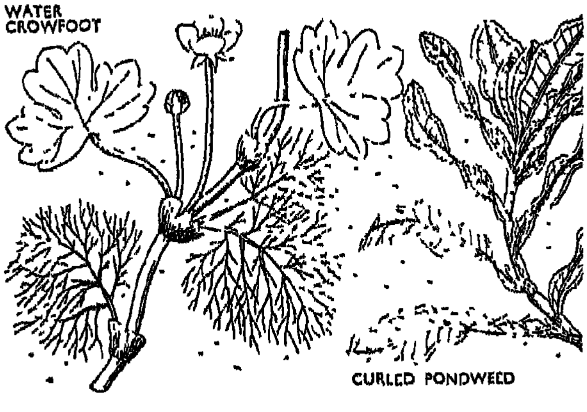
The tank is now ready for animals, and it is very important to discover the food of each, otherwise you may find that there is only one very fat one left. It is wise to have a lid of glass or perforated zinc, as many animals might crawl, jump or fly out. Space must be left for air if the lid is of glass.

Snails will probably be the chief vegetarian animals, and very few other aquarium animals eat snails. Some snails behave excellently, and when a fine green growth appears on the glass, rasp away at it with their long, toothed tongues (visible through the glass). Others have an annoying habit of eating away your plants at the base. You must experiment and see which kinds are satisfactory.

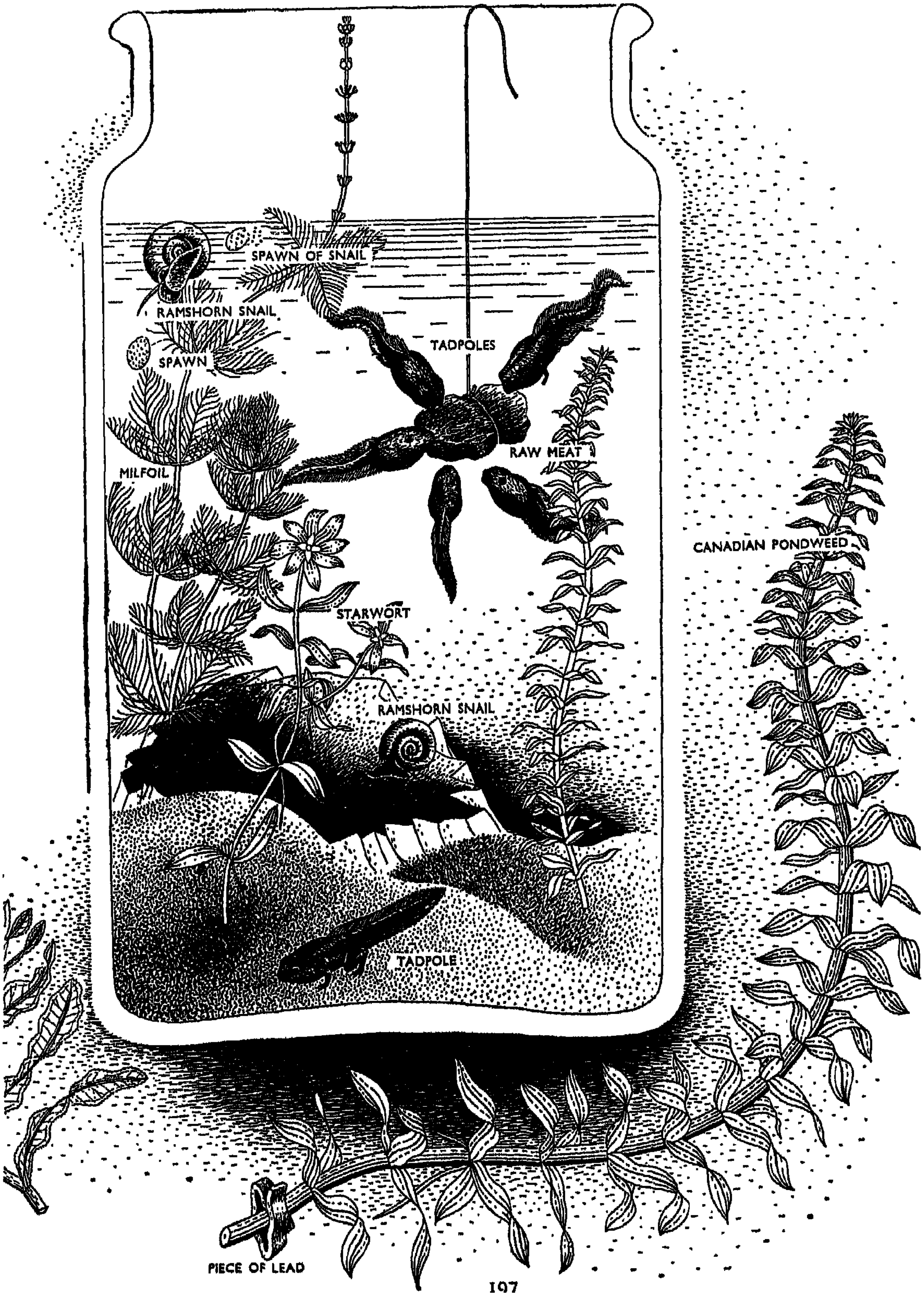
Caddises are interesting to keep in aquariums, since you can provide them with various materials and watch them making their cases. If you keep frog and toad spawn, you will see the newly hatched tadpoles hanging on by their suckers when first hatched. Then their mouths open, and the horny jaws are used on plant food. But soon they have to change to animal food and, if you cannot provide this, cannibalism will be the result. An inch-cube of raw lean meat may be suspended by cotton and the tadpoles will cluster around, or they can be supplied with tiny animals sieved with a net from any well-stocked pond. Many rain-water tanks contain red blood-worms at the bottom and water-fleas above. As a last resort, those who do not mind may provide chopped-up earthworms as a very acceptable food.

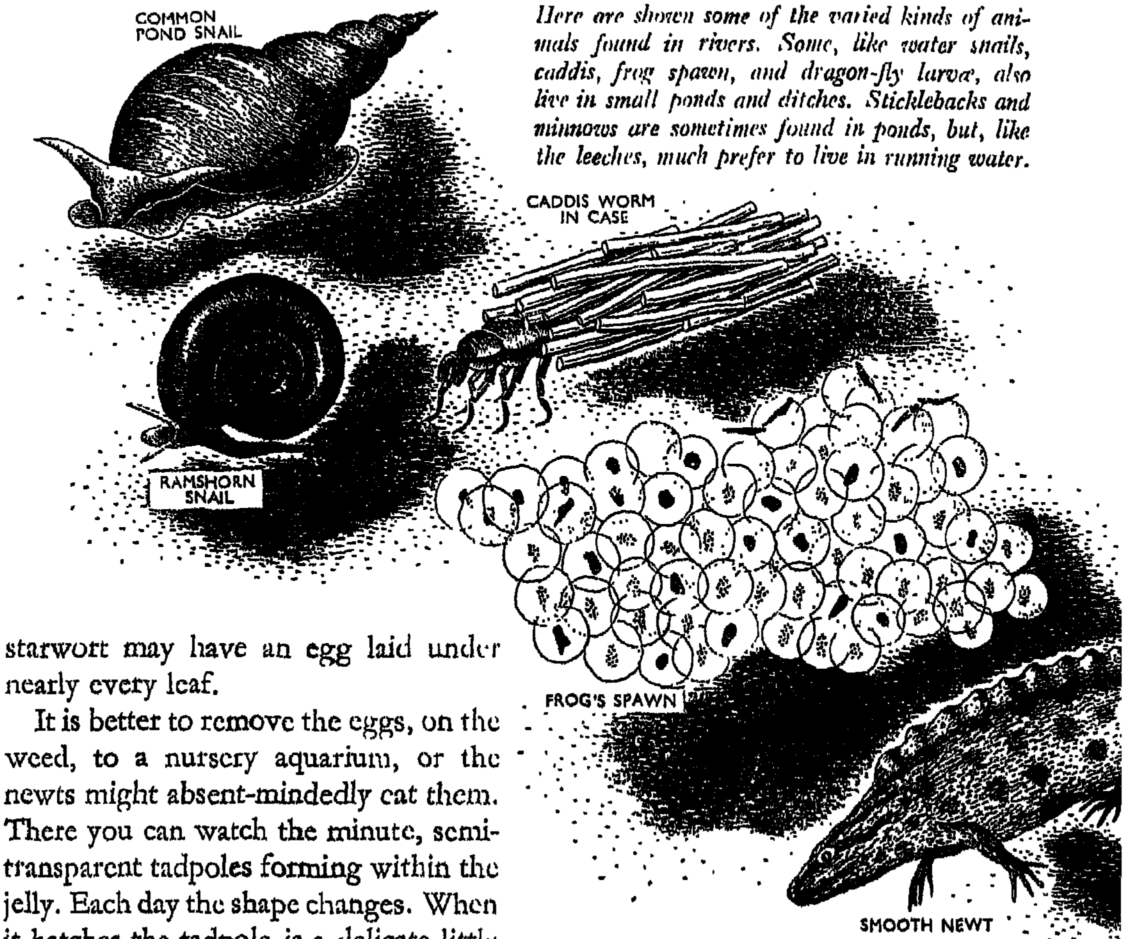
When tadpoles grow their front legs and appear like small tailed frogs, some way of escape from the water must be provided, either by tilting a tank and putting earth and plants beside the water, or by floating little rafts of cork or bark on to which the young frogs can climb. They will then need to be freed, as they are very hard to feed.

Adult newts caught in April or May will probably breed in aquariums. The male will move up and down, waving his tail and parading his crest and spotted waistcoat, while the female, resting on the bottom or suspended with one arm hooked casually round a plant, appears to ignore him. However, she can be seen later carefully wrapping a leaf over each cream-coloured egg in its oval jelly covering as it is laid. A spray of



A SIMPLE AQUARIUM


SPAWN OF SNAIL
RAMSHORN SNAIL
SPAWN
TADPOLES
RAW MEAT
MILFOIL
CANADIAN PONDWEED
STARWORT
RAMSHORN SNAIL
TADPOLE
PIECE OF LEAD

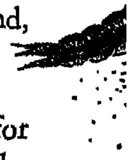


Here are shown some of the varied kinds of animals found in rivers. Some, like water snails, caddis, frog spawn, and dragon-fly larvæ, also live in small ponds and ditches. Sticklebacks and minnows are sometimes found in ponds, but, like the leeches, much prefer to live in running water.

starwort may have an egg laid under nearly every leaf.

It is better to remove the eggs, on the weed, to a nursery aquarium, or the newts might absent-mindedly eat them. There you can watch the minute, semi-transparent tadpoles forming within the jelly. Each day the shape changes. When it hatches the tadpole is a delicate little creature compared with a podgy frog tadpole. Three pink, branched gills stand out on either side of its head. The big eyes are shining copper in colour, and the front legs, with the most minute toes, appear before the hind limbs.

Baby newts need daphnia and other tiny animal food from the time they hatch. Adult newts will need the foods described for tadpoles. They easily learn to swim up and take a fragment of meat impaled on a piece of thick (not sharp) wire. This is gently moved about, so that the newt thinks the food is alive. Newts also need floating rafts, and when they begin to come out and lie on these it is time for them to leave the water. It is best then to take them back to a pond, from which they can crawl out at will. The newt tadpoles will not lose their gills and want to come out on land for several months, sometimes not until the next spring.

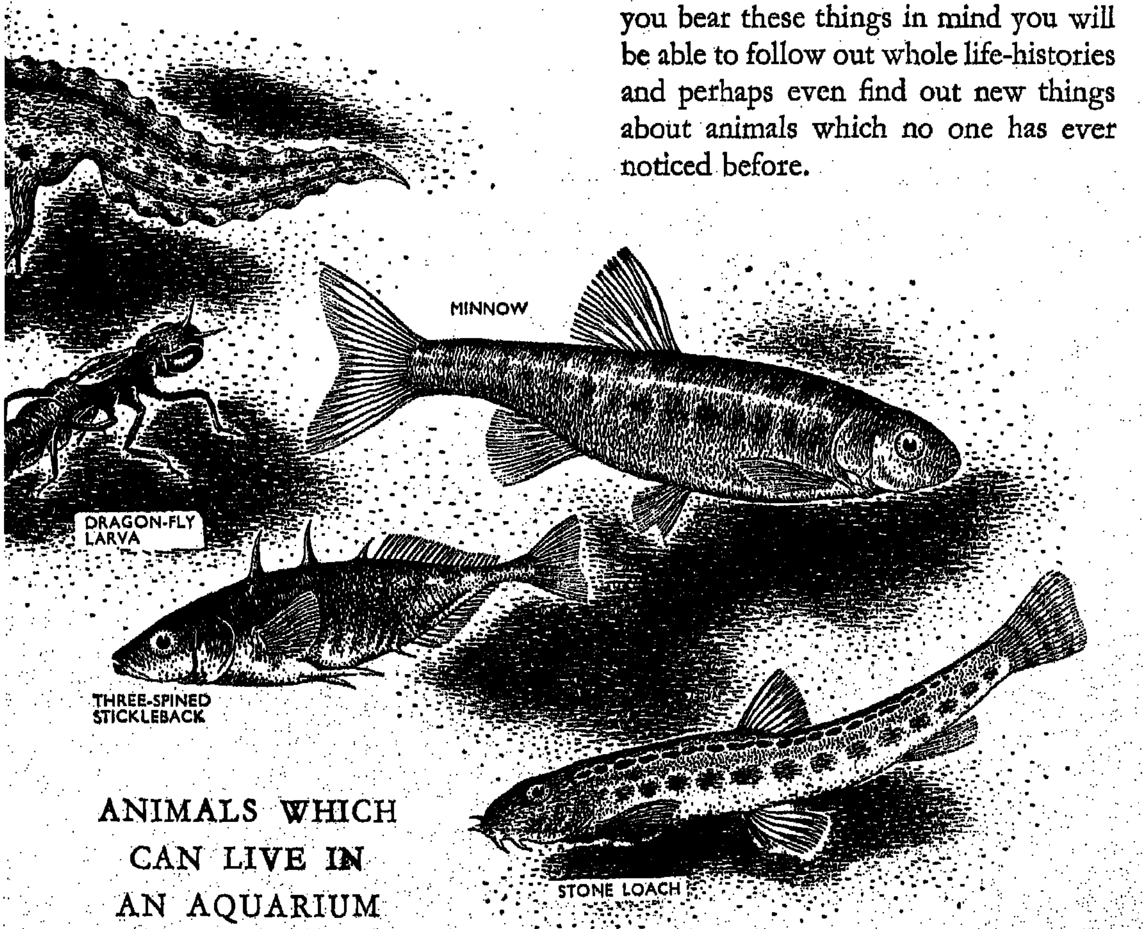


If dragon-fly larvæ are to be kept they must be well fed, and their natural diet is tadpoles. It is often best to keep only those which are almost ready to emerge and will not need many tadpoles. A stick up which the larva can crawl must be put in the water. This should stand up firmly, rise a foot or two above the surface, and be rough enough to provide a good grip. When the larva stops feeding it will generally rest for a day or two and then climb up. The small types of dragon-fly emerge far more quickly, and are often ready to fly about half an hour after leaving the water, but the big dragon-fly's transformation often takes several hours.

Never try to keep many animals in one aquarium, for they need plenty of space and oxygen. Fish especially must not be crowded. Sticklebacks, minnows, and stone loach are fish which do well in aquariums, and all need animal food.

It should not be necessary to change the water in an aquarium if the plants are growing well and the animals are healthy. If an animal seems ill, transfer it to a quarantine tank.

Always remove (with a finger over a long glass tube) any uneaten food or other material which might decay and cloud the water. Keep a cardboard shade at the back of the aquarium if it is in strong sunlight. If filaments of flannel-weed are allowed to grow freely they will obscure the tank. It is best always to keep the water at the same level, adding fresh water at the same temperature. If you bear these things in mind you will be able to follow out whole life-histories and perhaps even find out new things about animals which no one has ever noticed before.



ANIMALS WHICH CAN LIVE IN AN AQUARIUM

Life of the river

If you stroll along the river-bank on a summer evening all sorts of animals will be there as well, and your walk will be only one of a hundred series of movements by the river. But most animals will hide at the sound, scent or sight of a human being, and to see them you must be looking and listening very intently. To understand what you see and hear, you need to have some knowledge of the habits and haunts of these animals. Man-made roads mean little to animals, and a path by a river, or even the water itself, may be their highway.

All animals need water, and many regularly visit a stream each evening to drink. Besides domestic cattle and horses, in various parts of the country roe and red and fallow deer, badgers, foxes and others may be seen coming down to drink and in some cases to hunt. Creatures such as water-voles, otters and herons have a more intimate link with the water; they live near it and rely on it for their food, whether plant or animal. For many animals the river is their world, and they never go beyond it.

There is always something going on by a river. As you wander along you will perhaps see a line of bubbles floating up to the water surface. What animal is making them? Or you may hear a plop as something slides into the water. What was that? A brief clear song of sudden harsh notes comes from the reed beds. What birds are hiding there? A little bay of wet mud or sand may show clear footprints. Which animal left those tracks? Is there a double line of prints showing where a stoat, perhaps, came to the water's edge, or is there but a single line leading away, indicating that some animal came out of the water here?

The upper reaches of a river show the greatest contrast to pond conditions for the lives of plants and animals. In a pond, small feeble animals and their larvæ can float gently about and need not be powerful swimmers. But in hurrying, disturbed, broken waters, such as those of the Scottish Highlands, the Welsh mountains, the Lake District and the streams of Exmoor or Dartmoor, any animals which cannot swim strongly, or cling firmly to weeds or stones or lie flattened beneath them will be swept away downstream.

So the shape and habits of all animals, both young and grown-up, must be specially adapted to life in torrents. This is well seen if you compare the insects

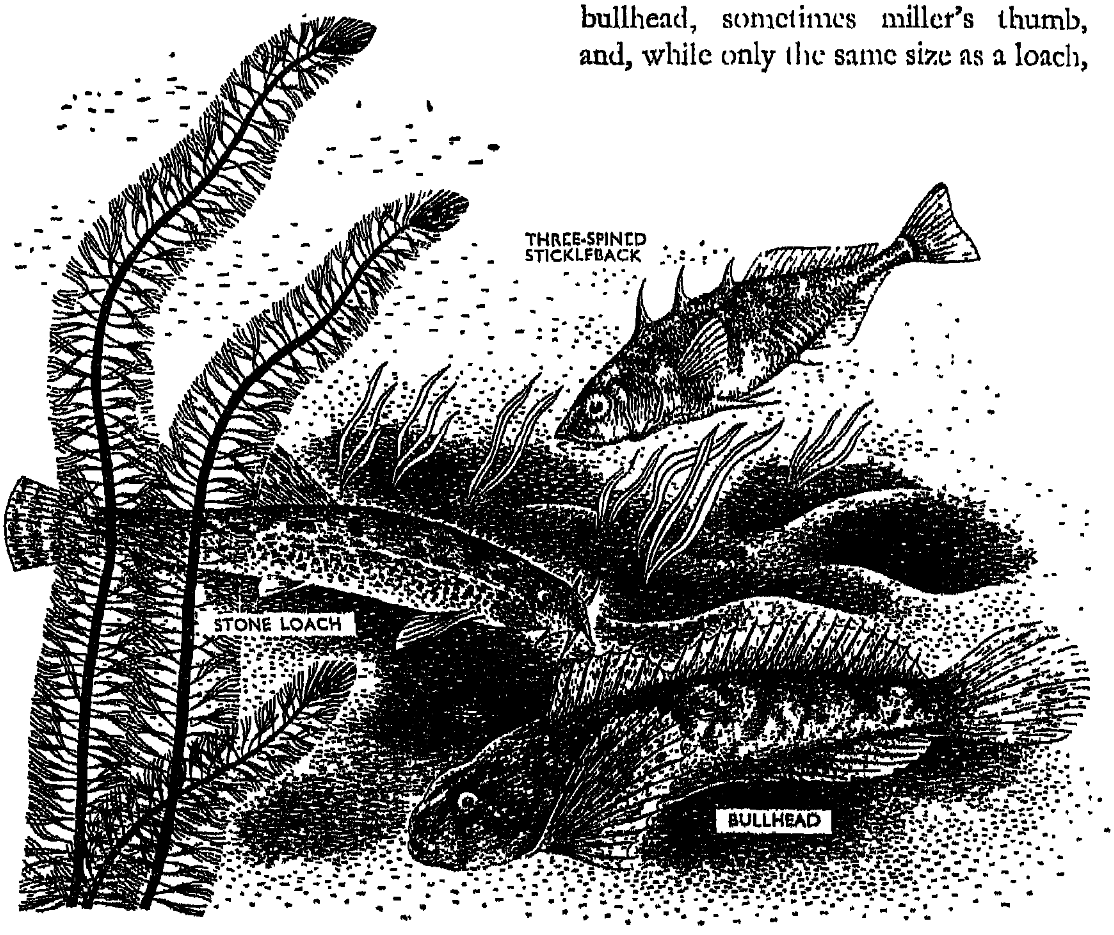
One of the most common flesh-eating animals is the stoat. During winter in Scotland, and sometimes in England, it changes its chestnut-coloured coat for a white one, though the black tip of the tail does not change. The white fur is known as ermine. The stoat lives mainly on animals such as rabbits and field mice, but it can also swim and catch fish.

you find in ponds with those from hill-streams. Instead of wandering about freely, many of the swift-water caddis larvæ will make their own homes of particles of sand, small sticks, leaves and so on, held together with a kind of silk which they make themselves for the purpose. Others will lurk in minute crevices after each has spun and fixed its own little silk fishing-net, waiting until food is brought into it by the current.

Both mayfly and stonefly larvæ can be found if you pick up fair-sized stones and look quickly underneath them before the insects have time to slither off into the water. Nearly all the larvæ are so curiously flattened that they appear paper-thin as they press tightly against the stones. Nothing can remain floating, so there is very little life of minute size. The animals have either to eat plant food, or be able to snatch at animal food as it passes. Even the plants stream out with the current, and only certain small water-plants and mosses are able to survive.

Some fish can feed and live in these streams, remaining in the deeper pools in summer when the shallow waters become a mere trickle. Little brown trout show their red spots as they dart swiftly into hiding. In many parts of the country two kinds of rather odd-looking fish may be found lurking under stones. One of these, the stone loach, is hard to see until it moves, as its four or five inches of mottled brown and yellow match the colours of the stones and mud. It is a slender fish, with very small eyes, and is most easily recognized by the six barbels or feelers sticking out around its mouth, rather like a moustache. We cannot taste food until it is in our mouths, but a loach is thought to use these barbels both to feel and taste as it wriggles along the bottom of the river seeking food by night.

The other fish is sometimes called bullhead, sometimes miller's thumb, and, while only the same size as a loach,

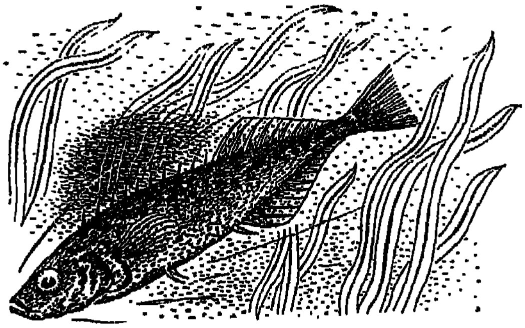


The three-spined stickleback (TOP), *stone loach* (CENTRE), *and bullhead* (BOTTOM) *are all freshwater fish. The male stickleback defends the weed-tunnel nest in which eggs have been laid. The two spines below the eyes of the stone loach are very sharp. Like the loach, the bullhead hides from its enemies, the pike and the trout. The curved spines on its gills make it a dangerous meal for its attackers.*

has such a huge head for its size, such a gaping mouth, red eyes and spiny appearance that it looks quite ferocious. Like its cousin, the stickleback, the bullhead cock-fish guards the eggs, which are stuck to the stone roof of a hollow under a rock.

Many birds visit hill-streams. The grey wagtail nests near the water, sometimes paddling as it picks up small creatures for food, or flying up to catch winged insects. This wagtail is similar in shape to the familiar pied wagtail, but its back is slate-grey and greenish-brown, and it has a beautiful bright-yellow breast. In boggy parts snipe with long, delicate beaks will probe for worms, and in summer the ring ousel's clear whistle will sound from mountain regions. This bird is closely related to the blackbird, and much resembles it in colour and habits, but it has a conspicuous white bib, and is found only by hill waters.

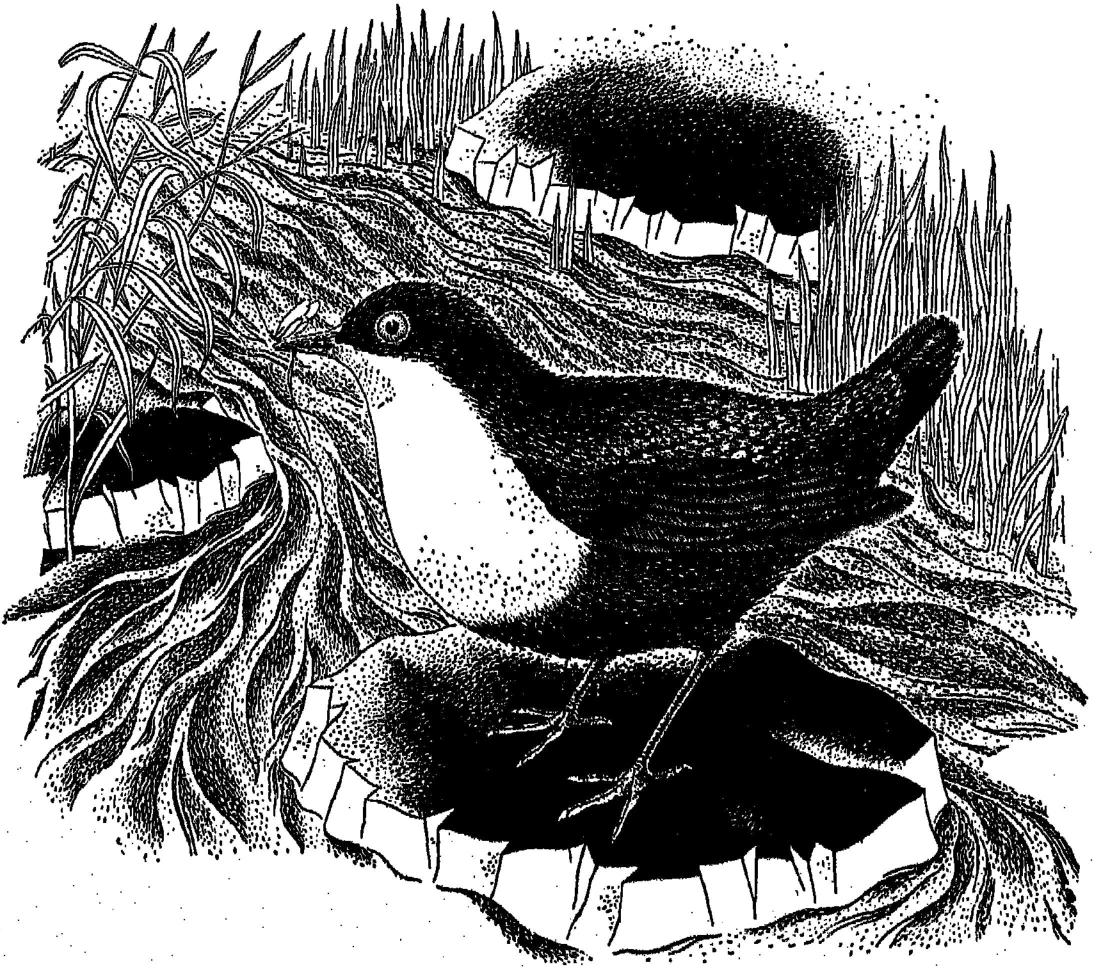
In these parts, and also farther down swift-flowing rivers, lives the dipper or water ousel, a little bird whose ways are as amusing to watch as its song is enchanting to hear. It is most often seen standing on some exposed stone in the water, bobbing up and down in jerky little curtsies. Its white throat and breast stand out from the dark-brown and grey plumage. If alarmed it flies straight up- or downstream for a short distance, showing its small, swiftly whirring wings and rather stumpy tail. If it does not know it is being watched you may see it dive or walk off its stone into the water.



Not as common as the three-spined, the ten-spined stickleback swims about in large shoals while it is young, searching for small water animals to eat.

If the water is clear you may have the luck to be able to watch the dipper using its wings to swim, making every effort to remain down while it hunts on the bottom for snails, caddises and other small animals. You will probably see it probing cracks for food, clinging tightly with its claws, then quickly rising and popping above the surface and out, only to dive below again for another food hunt. Dippers devour many of the enemies of young fish, but there is no evidence of their eating fish-eggs or fry. The nest is in a hole or rock crevice in a river bank, or under an old bridge, or often right behind a waterfall, where the bird has to fly through the spray at each visit. It is domed like a big wren's nest and lined with leaves. Four to six babies are reared, and the dipper may have two or even on occasion three broods in one season.

If you walk beside a hill-stream after a drought you wonder how this gentle little brook could have carved out so deep a bed or could have carried down all these great stones. But if you revisit it after many days' rain, or when the snow has melted in the mountains, the gentle stream will have been quickly transformed into a raging torrent. In



The dipper, or water ouzel, catches much of its food by using its wings to swim under water. Its nest will be found in a wall or bank and consists of dead leaves and grasses. It is carefully camouflaged, green moss being used if it is near a waterfall where spray keeps vegetation green. The entrance to the nest consists of a small hole at the side low down.

their lower reaches, however, most rivers flow quietly and peacefully. Yet even broad, slow-flowing rivers occasionally flood, and afterwards sticks and grass caught in branches mark the high-water level, and many animals will have been driven from their homes.

Across many rivers man has built dams or locks to control the amount of water passing down, to provide water supplies for cities and to make the waters navigable for boats. Dams and locks will not interfere with all types of animal life, but the towns built by man upset it seriously. In many places where the waste products of factories and town sewage are allowed to flow into rivers, even after treatment, miles of dull, discoloured, lifeless waters are the consequence. Every kind of plant and animal living there is killed and, of course, none can pass up or down. This pollution has ruined long stretches of many once-beautiful rivers, although it is not an essential result of the growth of big towns and cities.

ALONG THE RIVER

In this second part of the river, between the hill-streams and the tidal region, there will be plenty of variety. Sometimes the river flows between steep wooded banks, sometimes through water-meadows, where it may meander in wide curves across a broad valley. Here will be places with swift currents at the outer edges of the curves, where the banks are always being cut away, and, by the inner curve, stiller water, for those plants and animals which prefer it. Sand, shingle or mud banks may break the surface, and little beaches alternate with high banks. In these reaches will grow many of the same plants which are found in ponds. They will sway gently out with the current below water, and some kinds will have leaves and flowers appearing above the surface.

On a sunny day in the country it is pleasant to lean idly over an old stone bridge and just wait to see what happens. There may be a muddy place below the bridge where cattle come to drink, and there you can watch house-martins collecting beakfuls of mud with which to mould their cup-shaped nests. On the other side of the river the bank is steep and sandy, and flying in and out of nesting-holes in it are the smaller, brown sand-martins.

Some of the holes are too low down to belong to birds, and are probably owned by rats. The destructive, dirty and thoroughly detestable brown rat often lives by the water, and is a good swimmer, but we may well hope the holes belong to the water-vole. This clean and harmless little beast is often called a water-rat, but is not closely related to true rats. Peering out of its hole, with a fluffy little face when dry, bright eyes and superb whiskers, the water-vole slips into the water with a plop and swims under water to a tangle of reeds and irises. Here it comes out, bites off a green stem and sits up on its haunches to feed.

Fashions differ; it is the correct thing for a vole to have orange teeth, and this vole's orange, chisel-like teeth make short work of the stem which it holds between its hand-like paws. When it has finished it cleans its fur all over very carefully with its mouth and little paws, then dives into the water again.

RIVER FISH

As you look down at the weeds waving in the shadowed water below the bridge, one seems to detach itself, drift away, and then stay swaying faintly as before. You suddenly realize it is not a weed at all, but a fish, and as your eyes get used to peering down through the water you pick out more and more. They are all facing upstream, breathing as the water enters their open mouths and passes over the gills as it goes out under the gill-covers. In stagnant water, fish must constantly open and shut their mouths and gill-covers to breathe, but they can lie facing in any direction. From above, the fish appears the same colour as the weeds and stones, but, as one moves, a flash of silver-white shows for a moment from its under side. It is difficult for anyone who is not extremely familiar with fish to recognize many when they are seen from above.

SHOALS OF MINNOWS

In the shallows, shoals of tiny fish mill round, scattering in fright, regrouping and wheeling together in a mass. Some will be the young of bigger fish, but shoals of minnows which are seldom longer than three inches are common. They prefer clear, fairly fast-flowing water and investigate everything in an inquisitive manner. Minnows flash like silver in the sunlight, but if you examine one in a jar of water it will change its colour considerably, partly according to its feelings, and show grey or gold flushes. Minnows eat any small insects, and often gather in crowds round some bigger piece of food.

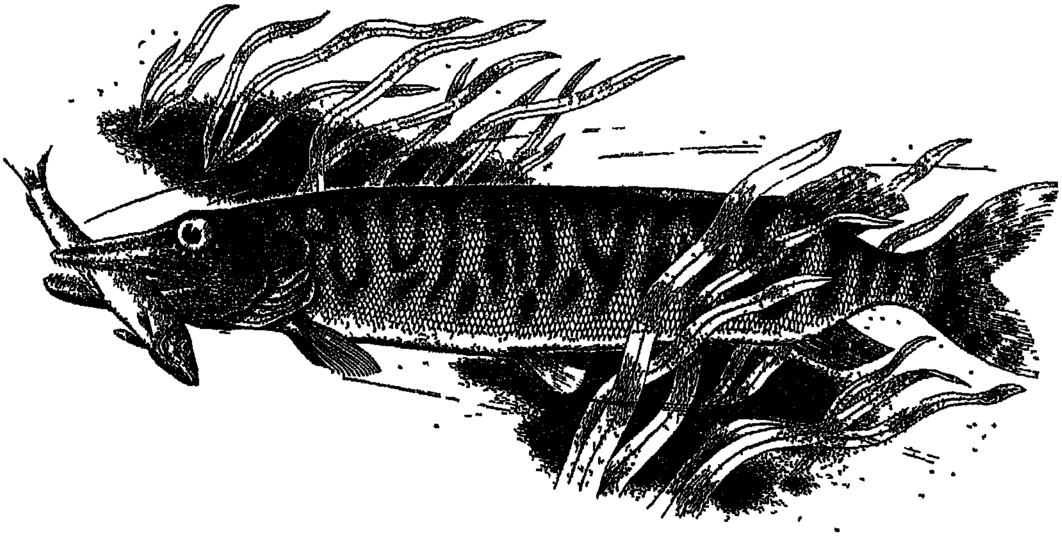
Both water-voles and minnows are the prey of many larger creatures, including one of the biggest fish in the river, the pike. Young pike or jack are often ferocious, but old pike must be terrifying ogres to very many water-dwellers. The pike's long, flat head bears immensely powerful jaws, and a pike may swallow any other fish nearly as big as itself.

Fish often have teeth growing not only in rows round their jaws, but also on the roof of the mouth, on its sides, even on the throat and tongue. Each hooked tooth points backward toward the throat, making the way down easy but escape almost impossible. Once the jaws close, the most slippery fish will find it hard to wriggle free. Pike seem limited in size only by absence of sufficient food, and there are records of these fish reaching four and five feet in length, and weighing fifty pounds. These monsters may lurk in both river and lake. Cock- and hen-pike, unlike most fish, remain in pairs throughout the autumn and winter until eggs are laid in spring. The young are solitary from infancy, spending all their energies in eating, whether their prey is fish, bird (such as duckling or moorhen) or mammal like water-vole or shrew.

ACTIVE WATER-SHREWS

Water-shrews are slightly bigger than the small land-shrews so often killed and left uneaten by cat or dog. They are far rarer than water-voles, and eat only animal food. They are extremely active, restless, irritable little beasts, nesting in burrows in the river bank, but hunting their food in the water. Their velvet fur is dark brown or black above and white below. The air clinging to the close fur makes them appear silvery as they dive to the bottom and hunt for minute animal life under stones and in the mud. Unlike voles, which have blunt muzzles, water-shrews have long, mole-like snouts, tiny eyes and pointed, red-tipped teeth. They are about by day and night, always hunting for food with insatiable appetites, and like clear, slow-flowing water best.

In some of the rivers of the southern



The pike is a pirate. Living in river, lake, canal, or pond, it preys on ducklings and water-rats as well as fish. Old fish may grow to as much as four feet in length and they sometimes weigh over fifty pounds.

part of the British Isles, crayfish are still to be found. Long ago they were caught in large numbers, sold in the markets, and considered very good to eat. A crayfish resembles its relation the lobster, but is only about four inches long, and yellowish-brown in colour. All have claws, and the males have one extra big claw, which can pinch extremely hard. Crayfish are most active at night, crawling about on the bottom as they hunt for food. Like lobsters, they often fight among themselves. When a crayfish is in a hurry, it swims backwards in jerks, moving by vigorously flapping its widely spread tail fin.

In strong daylight, and during the winter months, crayfish retire into burrows in the river bank, and remain inactive. If you find some crayfish in the spring, the females will have perhaps two hundred little round eggs attached to the small swimming legs underneath. The infant crayfish hatch in May or June, and for a few days these huge-eyed, leggy little beasts will remain clinging to their mother, before adventuring on their own. As the young crayfish grow, they have to moult their shells at intervals, just as lobsters, crabs, and caterpillars must shed their skins to give room for new growth. In some countries are found freshwater crabs, but there are none native to Britain, although a few foreign crabs once got into the Thames, and some bred in its lower reaches.

Anyone catching an eel and drawing it up from muddy depths might well think that from birth it had led a dull life in that particular muddy reach of the river. Yet this long, slimy, muscular fish is a traveller on the grand scale. Every eel will have reached the pond or river where it lives only after a journey of many thousand miles, and most are destined to return along their track once more. Most fish lay their eggs in the shallow parts of the water where they live, but eels never breed in British rivers or lakes, or indeed anywhere in European waters.

EELS BREED IN THE SEA

When an eel is several years old—generally between five and eight, when it will weigh one to three pounds—it becomes filled with an urgent desire to go down to the sea. It seems that some fish are not restless in this way, or else they are unable to make their way down, for eels of fifteen to twenty years old have been found. In late summer all the eels seized with this irresistible feeling make their way from ponds, streams, reservoirs and other waters, even wriggling across fields, to reach the rivers and swim down to the estuaries. Eel-traps are often set on the rivers, and the number migrating is so large that in one trap in a small river as many as one hundred and sixty eels have been caught during one September night.

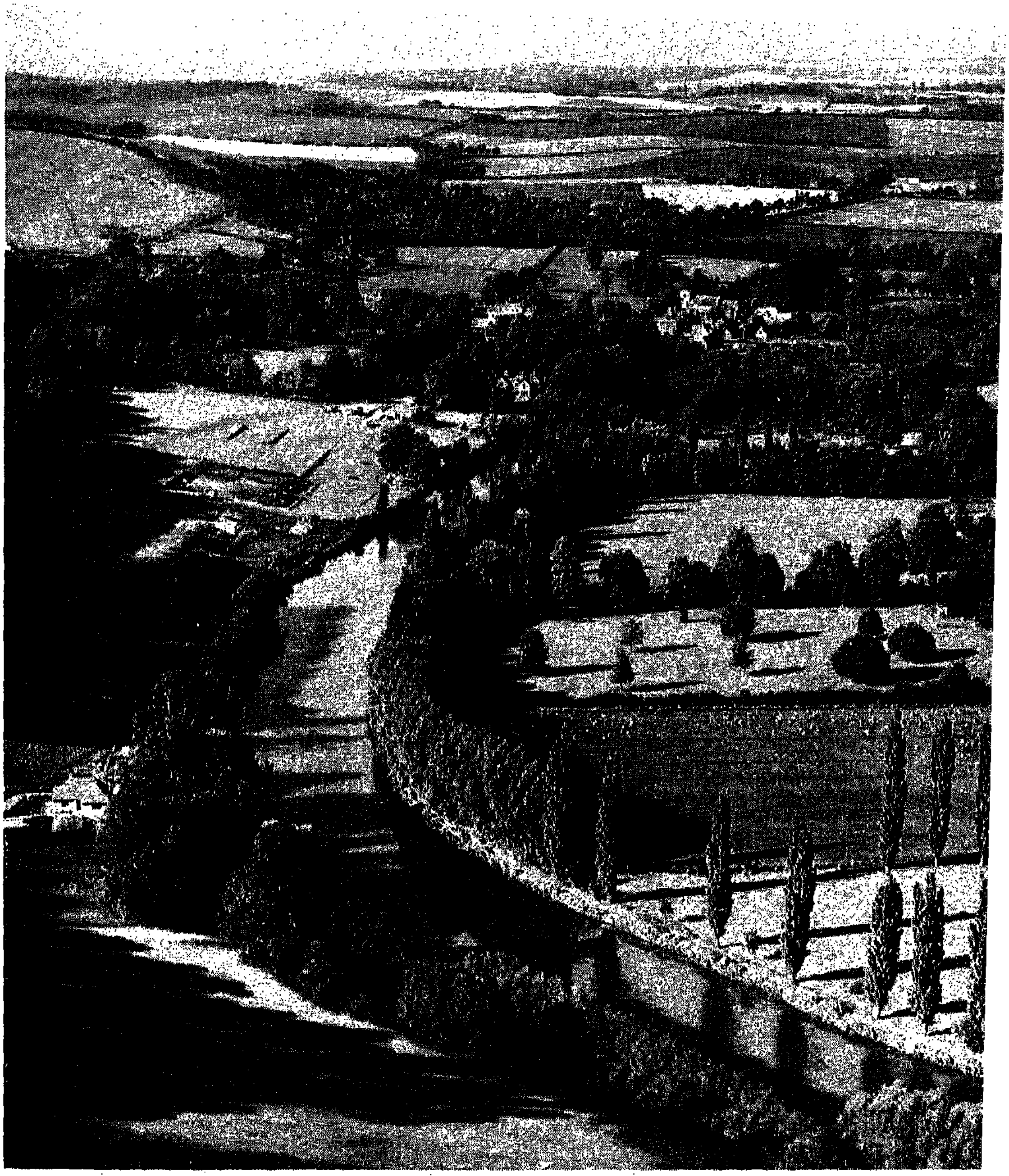
As the eels journey downstream their dull, yellowish-brown bodies become silvery, their coarse mouths finer and their small eyes large and shining. They are fat with good feeding and do not eat while travelling. From all the rivers the eels stream out into the sea, swimming toward the Atlantic Ocean, and make their way across the trackless ocean by a power we cannot explain (merely to call it instinct makes it no clearer). No eels have been caught after leaving the estuaries except in the Baltic, where the Danish scientist Johannes Schmidt worked while spending many years tracing their life-history.

All the migrating eels end their journey by diving deep below the surface waters in a region north-east of the West Indies near the Sargasso Sea. From the depths, it is thought, no eel ever returns. But this is their spawning ground, more than a hundred fathoms deep, and here myriads of tiny, transparent, ribbon-like infant fish begin their swim of several thousand miles in the opposite direction.

Scientists have drawn up the larval eels in nets and have observed them at different stages of their journey. The smallest found are only a quarter of an inch long, with typical tiny heads and tapering tails. Ocean currents steadily help them on their journey, and while millions are eaten on the way, the remaining hordes reach the coasts of Europe after two to three years. By this time they have grown much longer and now change their shape, becoming round instead of flattened, and grow less transparent and gradually darker. Then these little two-and-a-half-inch elvers, as they are now called, begin their mass invasion of the rivers of Britain.

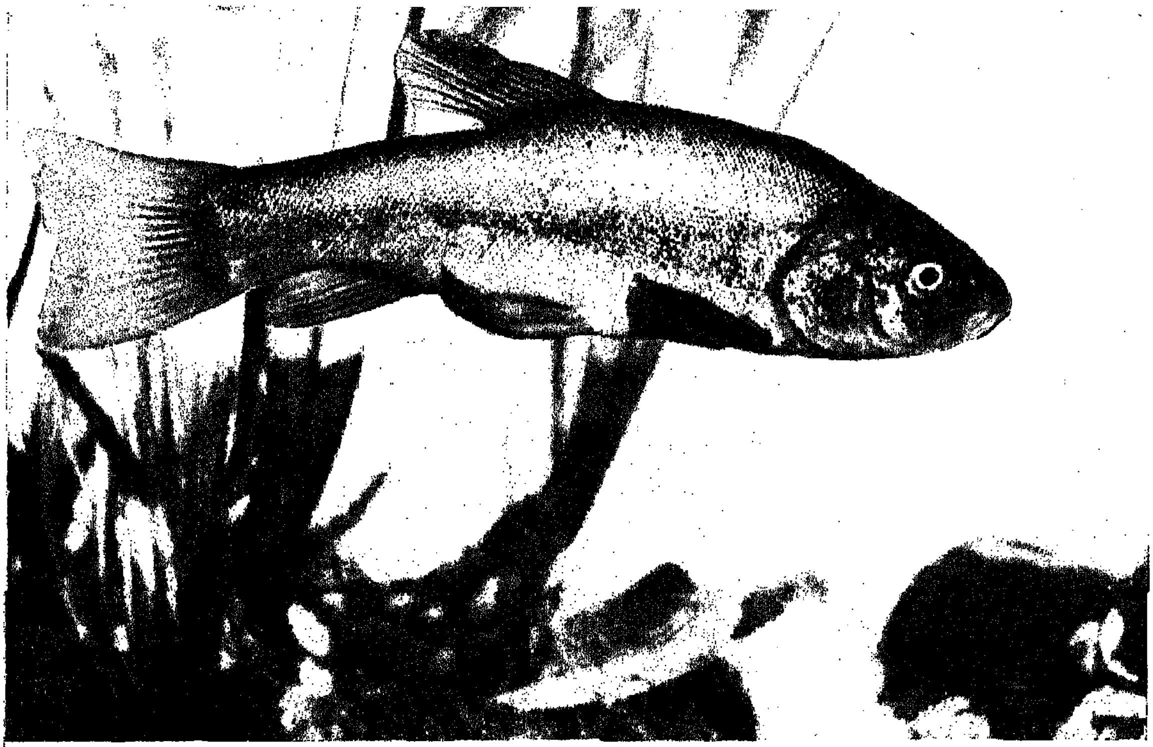
RIVERS INVADED BY ELVERS

In the early months of the year in the west, a little later on the east coast, hundreds of thousands of the little fish, head to tail, side by side, layer upon layer, surge up the estuaries. They branch off into tributaries, wriggle up weeds and mosses by the sides of waterfalls and re-populate all the waters with a



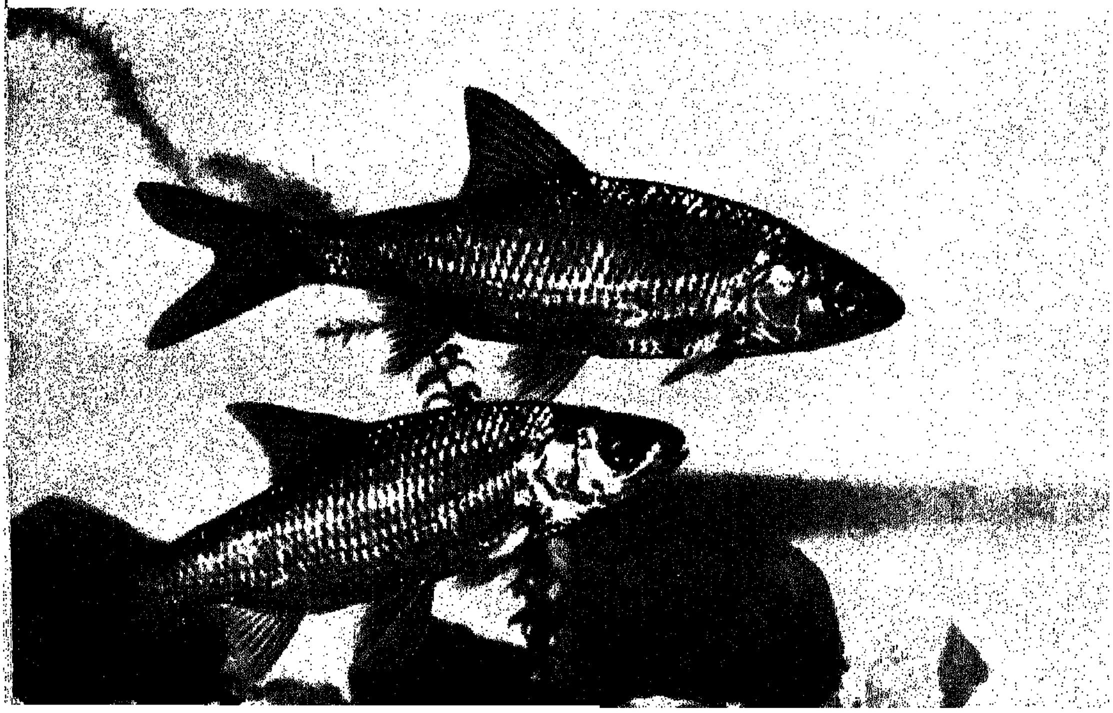
THE THAMES VALLEY BETWEEN PANGBOURNE AND GORING

There is always something going on by a river. In this gently rolling country the river flows smoothly. Along its banks and stretching far into the distance are fertile fields. The scene is peaceful and beautiful. But if you know what to look for there is more than just a beautiful countryside to be found by the river. All animals need water and many visit stream or river each evening to drink. Many of the plants found by the waterside live nowhere else. Fish and the other animals of the river all have their own interesting life stories. But wild creatures are shy; they hide from man. So to see all that happens by a river you must know something of what to look for and you will need care and patience to detect it.



ROACH AND TENCH

Roach (below) *are very common in the slow-moving rivers and streams of Britain. Most are between a half and one pound in weight and feed on water-weed, worms and other small animals in the mud. They are deep in the body, especially when well fed, and in the spring the green glassy eggs are laid in the mud or are stuck to water-weed. Tench* (above) *also pass their leisurely lives in slow-moving streams. During the day they rest in the mud. They eat water snails and decaying matter such as dead fish, so that they help to keep water clean. They come out for a meal and a swim in the evening. In the daytime tench can be caught by gently closing the hands round them as they lie in the mud.*



CARP AND PERCH

The carp (below) *is a handsome fish which may be recognized easily by its large glistening scales and the fleshy whiskers, or barbels, which are visible in the picture beside the fish's mouth. The carp feeds on a variety of food, from water-weed to small water animals, and grows to a large size. Fish have been taken weighing up to twenty-six pounds, they are known for their cunning and are hard to catch. Though the female lays hundreds of thousands of eggs, so many are eaten that only a few reach maturity. In the shadow of the bank or among weeds hide the perch* (above) *They dash out to capture a fry or small water animal, on which they feed Since young perch chase almost any moving thing, they are easy to catch Perch are easy to recognize because they have dark upright stripes across the body and two fins on the back They do not grow to more than three pounds in weight.*

WATER BIRDS

Along the banks of most British rivers are the homes of many water birds. In the photograph above the mother swan and her babies are entering the water. The mother swan is called a pen, the father, a cob, and the grey-coloured, downy youngsters are cygnets. It will be about two years before they are fully grown. In the spring, swans build their nests of reeds beside the water. Pen and cob take turns at warming the eggs and feeding the cygnets. In some places the nests are together in great swanneries and it is dangerous to walk among them at breeding time because parent swans may attack strangers. Below, *mallard are seen at their nest loosely made of leaves and grass with a lining of down. This bird is the ancestor of the domestic duck and is the most widely distributed of its kind in the British Isles.*

fresh generation of eels. Tremendous numbers are eaten by screaming gulls, excited herons and other birds, which have a grand time, and the elvers are attacked from below by fish and by almost everything capable of devouring them, but the numbers are so great that many remain. They find homes and gradually grow into typical eels with small heads, small fins and snake-like bodies as shown in the picture on page 211. In some rivers, especially the Severn, innumerable elvers used to be sieved from the water each year and exported to the Continent, where they were fattened to provide food for human beings.

THE KINGFISHER

A darting flash of brilliant blue or emerald is often the only glimpse we have of a kingfisher, yet these birds keep strictly to their own beat of the river, so you are likely often to see one in the same place. They have favourite perches on posts or boughs overhanging the water, from which they watch for fish. If you examine possible spots and find one with fish-scales on it, that 's the perch to observe from a hiding-place. A kingfisher has a short body and tail, big head and long, strong beak. The colouring is gorgeous and unmistakable, the greenish-blue back, head and wings contrasting with orange-pink breast. When it sees a fish below, the kingfisher plunges in like a dart. Sometimes it misses, but often it flies up to the perch holding its prey firmly across the middle. The fish's head is then knocked sharply against the perch and the kingfisher swallows his meal head first. Sometimes kingfishers hover and then dive into the river.

You would never guess that so exquisite a bird would have such a foul-smelling nest. But kingfishers are far less particular than most birds, perhaps because few enemies can reach the oval tunnel in a high sandy or clay bank which leads to the nest. They often choose a double bend on a river, with a deep pool for fishing. The hole starts clean, but when six or seven young birds are constantly having fish taken to them, and leave bones and bits to decay, the tunnel becomes horrible. We cannot wonder that a parent bird, on leaving the hole, may plunge at once into the fresh, clean water below. Sometimes kingfishers are shot because they catch young trout as well as other fish.

Some of the trout and salmon family may also, like eels, migrate and travel long distances. All the fish of this family are distinguished by a small, rounded, thick fin between the back and tail fins, known as the adipose fin. Some members, such as the char, are found only in lakes, while the greyling keeps to rivers. Brown trout live in both, and used to live in nearly all British waters which were not stagnant. But man's interference and river pollution have led to their dying out in many regions.

FRESHWATER TROUT

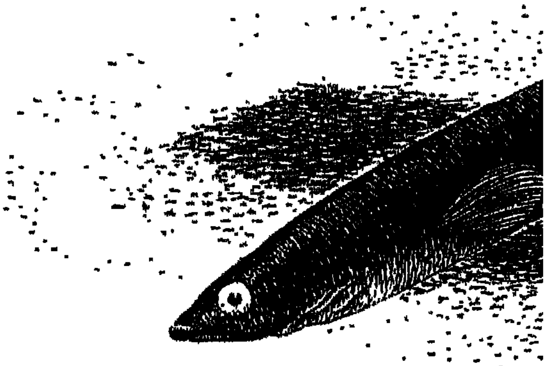
Brown trout vary in shape, colour and spots, and are paler in the chalk streams and darker in peaty waters. Anglers who know one district well may even be able to tell from which river or loch particular fish have been caught, since those living in the same place tend to be, for example, specially golden in colour, deep of body, or have extra-large red spots. Their size, apart from young fish, depends largely on the size of the water where they live and on the amount of food present.

Trout eat almost any small freshwater animals, and the older fish may become cannibals. They feed on the bottom on worms, caddises and shrimps, and rise to the surface to take mayflies, stone-flies, caddis and other flies as they hatch from their water-living larval stages, or fall, drowning, on to the water. Sometimes in summer thousands of one kind of insect will hatch within a few minutes, usually toward evening, and for about half an hour the surface of the water will be covered with ever-widening circles, each rippling out from a ring made by a trout's big, sucking mouth. In hill-streams trout seldom grow bigger than four ounces weight, but in big rivers and lakes two- to four-pound fish are a good size and occasional huge trout grow to thirty or even forty pounds.

Brown trout spend all their lives in fresh water, spawning in the shallows, but close relations of theirs have very different habits. The sea-trout (or salmon-trout), for instance, are hatched in fresh-water shallows like infant brown trout, but when they are older they go down to the sea. There they feed, but return to fresh water to spawn. When fresh-run from the sea they are shimmering in silver and white and easy to distinguish from brown trout, but after living some weeks in fresh water their colours darken and the silver becomes dulled.

Sea-trout behave in much the same way as their far larger cousin, the salmon. This great fish was named by the Romans "the Leaper," and it is a wonderful sight to watch salmon hurling themselves out of the water and falling back with a resounding splash. It is still more exciting, if you have the chance, to see them trying to leap sufficiently high to clear some obstacle in their path upriver, whether it is a waterfall, weir or some jutting rocks. Each year salmon run up the rivers from the sea. Some come up in an early run, some later in the year, and the runs vary from river to river.

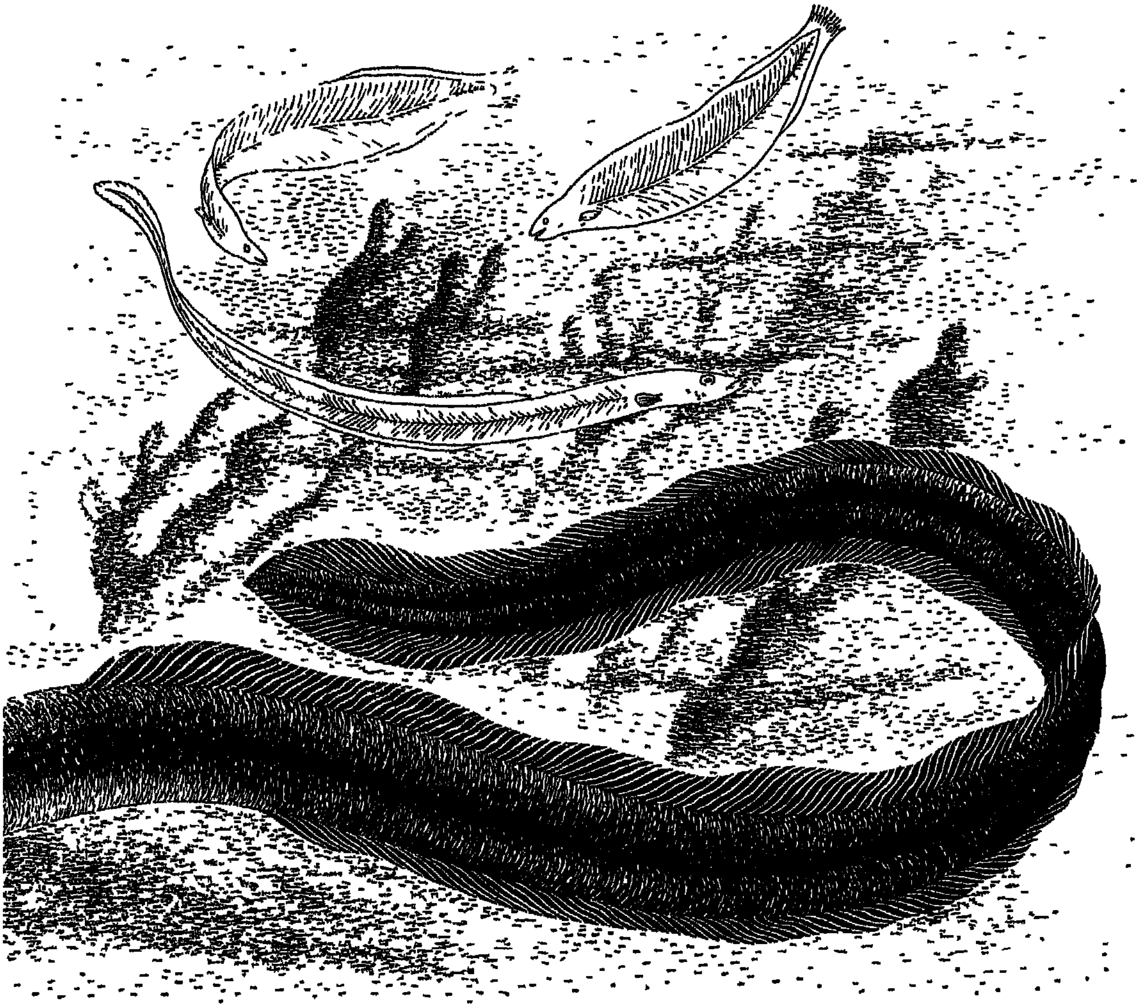
The salmon spawn in mid-winter, so those which come up early in the year may remain for months in fresh water, but those arriving in late autumn will not wait long. It is thought that salmon return to breed in the river where they

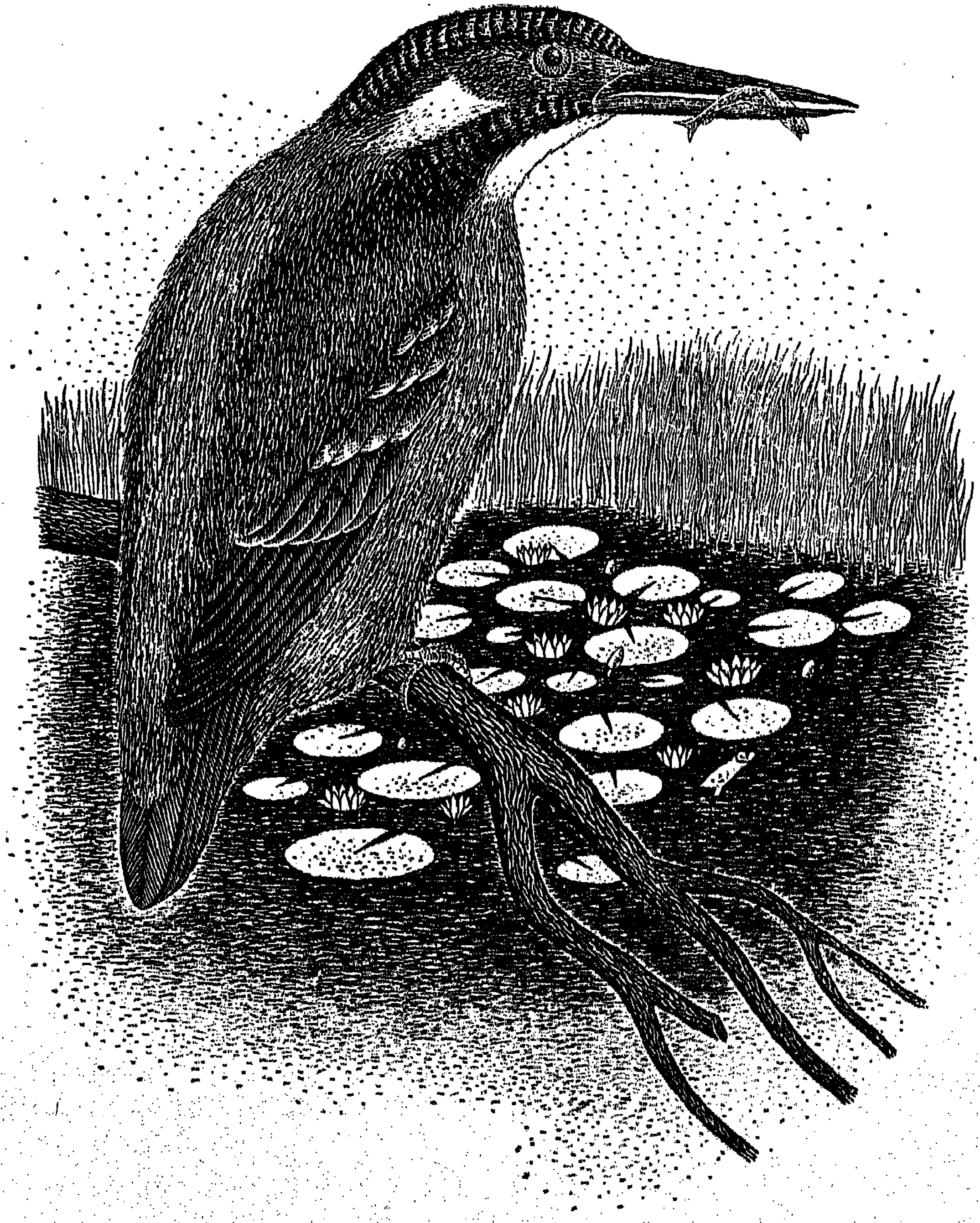


Eels live in both fresh and salt water and every year millions make their way from ponds and lakes to the rivers and so down to the sea. They may even travel over land in order to reach a river. On reaching the sea they swim out to their breeding grounds, which are believed to lie more than a thousand fathoms deep in the Atlantic Ocean. When the eggs hatch, the young (TOP) *begin their three-year journey back to the ponds and lakes.*

were born. Proof of this has been given by the recapture of fish, marked when they were young, in the same river. The marking is done by a small metal tag, or by fin-clipping. At one time these magnificent fish came up every possible British river, but now the water flowing through some large cities is made so foul that salmon cannot pass.

Large salmon, which may reach forty or fifty pounds in weight (giants of eighty and ninety have been recorded), smaller salmon and grilse, as the young salmon are called, enter the estuarie with the tide, when the river is in spate and gradually make their way up. The have fed well in the sea and are i splendid condition, brilliant in shinin silver. Many arguments take plac among anglers as to whether or no salmon feed in fresh water. If they d not, some say, why should they rise t take an artificial fly, or suck in worms Certainly internal changes take place The stomach of a salmon shrinks, an is always found empty. Most scientifi





Most brilliantly coloured of British birds, the kingfisher lives by the waterside and feeds on fish. It is often to be seen perched on a bough above a stream or river watching for its prey. The kingfisher builds its nest of dry fish-bones in a hole, about a yard long, usually in a sandy river-bank.

experts hold that they do not eat after leaving the sea. They never grow, and always lose weight in fresh water.

On and on up the rivers the salmon swim, resting awhile in deep pools, in the lee of steep rocks, or in the shelter of overhanging banks and boulders. In American rivers they may have to travel more than a thousand miles, but in many British streams their journey to the head-waters is short. In most rivers, however, they have to pass difficult places, where they can be seen leaping into a falling sheet of water, and often with violently wriggling body and flailing tail striving to force themselves up and over the final water-washed rocks into the easier stream above the fall. Many make effort after effort, falling back with the force of the water, and resting exhausted, until, springing from the bottom of the pool, they burst out of the water in a final successful leap. In many rivers salmon ladders are built to help the salmon evade places too difficult even for their power and spirit.

HOW SALMON BREED

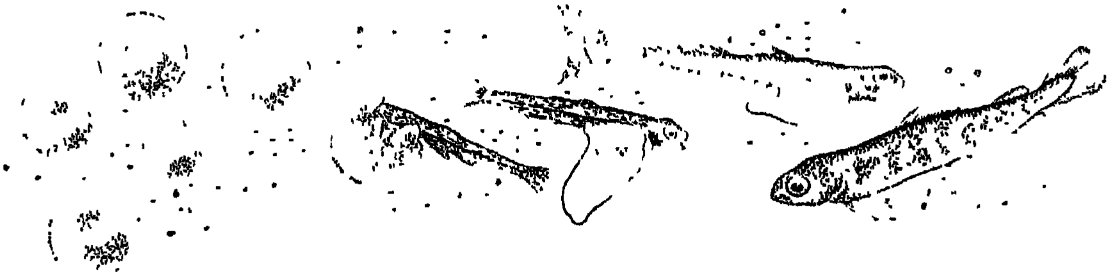
By the time the breeding season comes in mid-winter the salmon have lost their sea-fresh silver and become dark and dull. The cock-fish is a coppery reddish-brown, and his jaws have grown out into a great hooked beak, making him easy to recognize. They find places where shallow water is flowing not too swiftly over sand or gravel, and there the hen-fish drives forward on the bottom, ploughing a narrow trench, or redd, with her muscular tail. Here she begins to lay her eggs, and the cock-fish, which has been hovering near, fertilizes them. Then the gravel is pushed over the batch of eggs and they are left to develop.

The hen-salmon may make several redds, and lay eight or nine hundred eggs for each pound of her weight. The eggs are pea-sized, pinkish-yellow and translucent. They are very resilient, and so are not squashed by the weight of gravel above them, which prevents them from being swept downstream. It also protects them from some of the egg-eating animals.

YOUNG SALMON

At the end of winter the young fish hatch out. These are called alevins. Each had plenty of yolk in its egg to provide it with food, and at first the little yolk-sac is still visible below it. But this is quickly absorbed in the alevin's body, and it begins to dart about and snatch minute animals for food. Many get eaten themselves, but the little fish quickly learn to hide, to keep a constant watch, and only to dash out for food and rush back again to cover. As they grow they develop little dark patches down their sides with red spots between, and are now called parr.

When they are about two years old, and about five inches long, alevins are ready to go down to the sea, and, in preparation for this, turn silver and become smolts. In the spring the shoals of smolts make their way down the streams into the main rivers, down to the tidal regions and finally out into the sea. Here we lose touch with them, but for those which escape their numerous



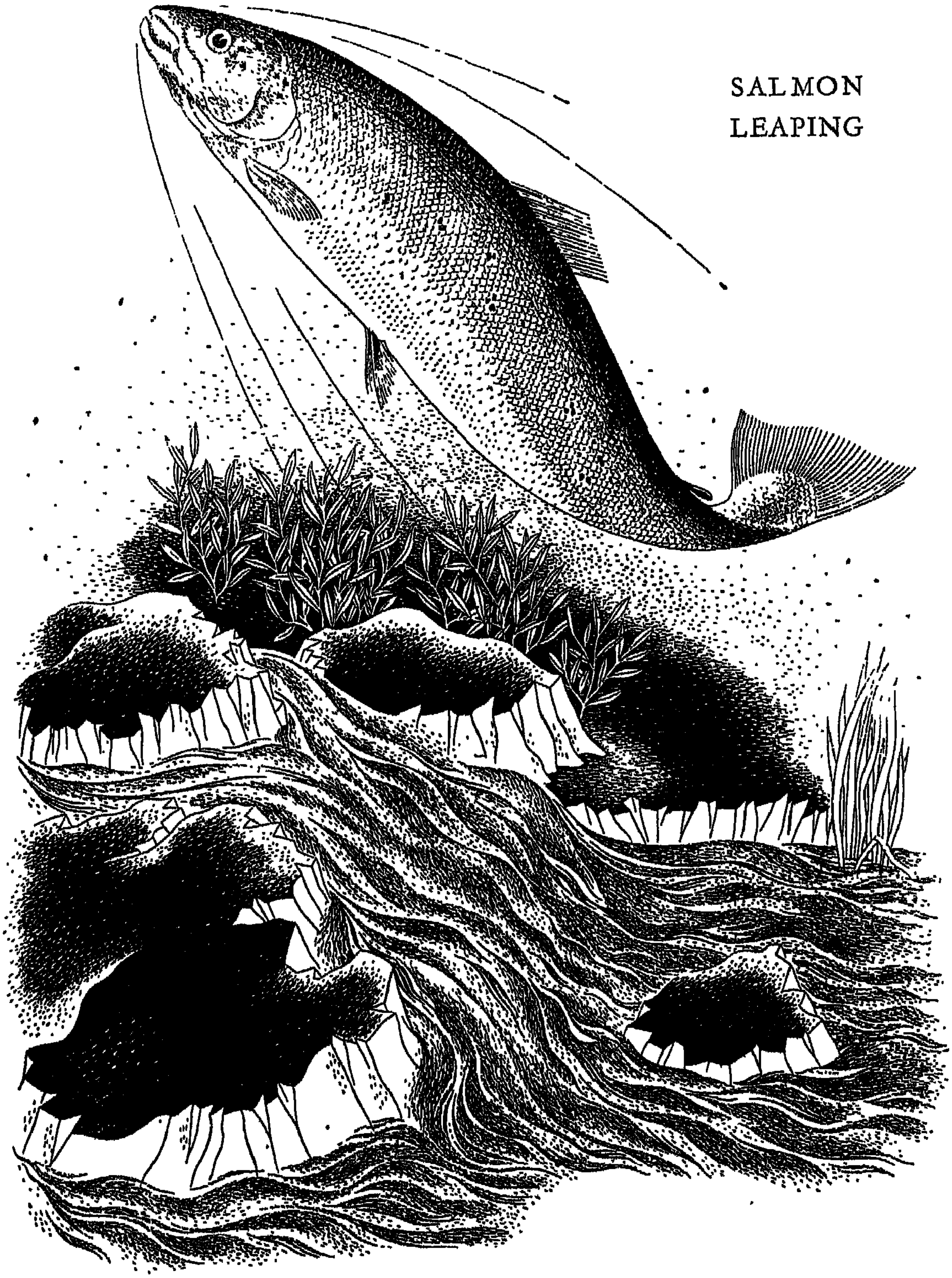
There are different names for the various stages of the salmon's life. The round eggs (ABOVE, LEFT) *are always laid in fresh water: they hatch out into alevins* (CENTRE) *which carry under their bodies little sacs containing food. By the time the food in the sac has been used up the alevins have grown into what are known as parr* (RIGHT). *As the parr grow up they are known progressively as smolt, grilse, and then as salmon, and, after spawning, as kelts. In order to spawn, the salmon travel from the sea far up the river. On the way up to the spawning ground they will leap up quite high waterfalls.*

enemies the feeding is rich. Their flesh turns pink and they grow rapidly. In the sea they will remain until, in their turn, they feel drawn by the urge to swim into fresh water, to move up the bubbling, oxygen-rich rivers and finally breed. They may come up the next year, as grilse weighing five or six pounds, or wait until they are five or six years old.

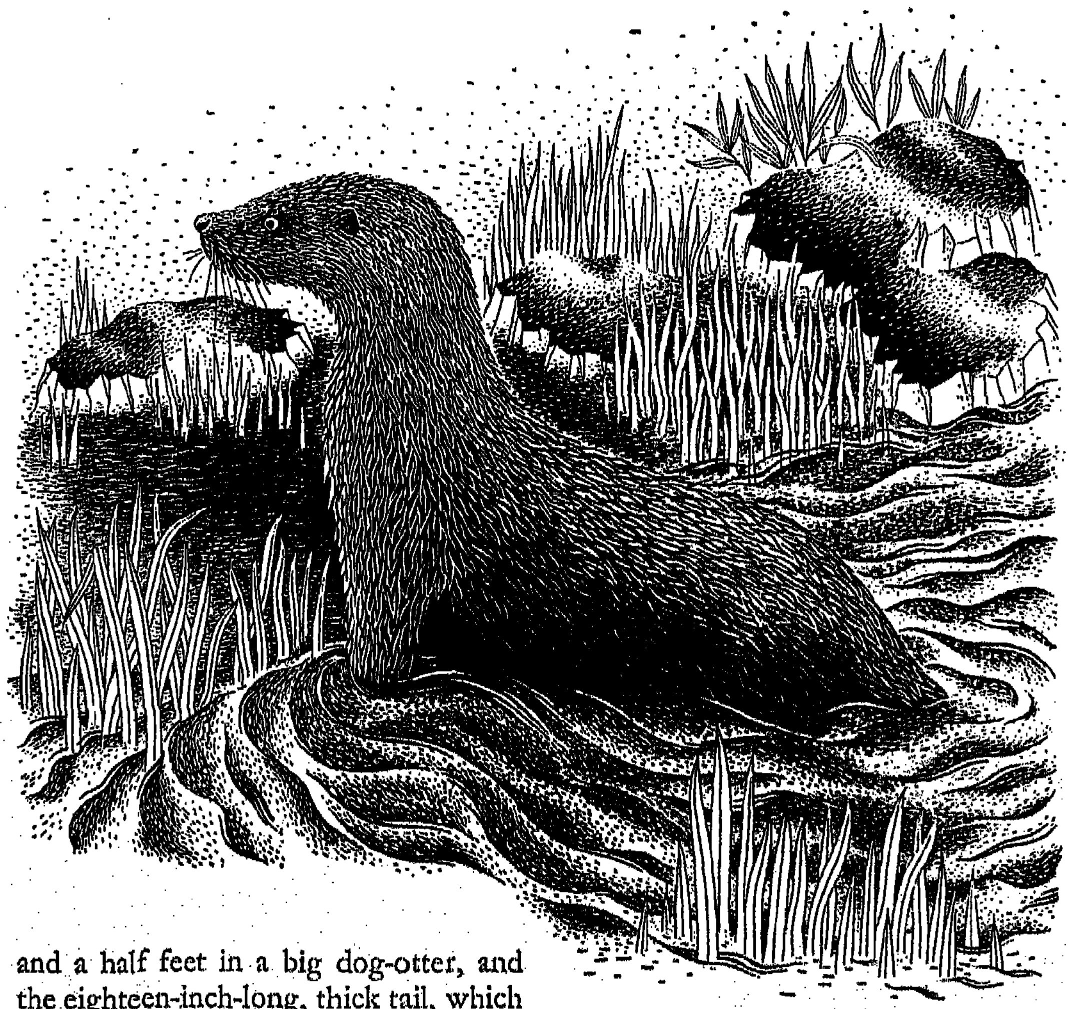
Once salmon have spawned they are in a very poor condition and are called kelts. They have digested no food for a long time, their once-firm flesh is soft, their dingy bodies limp and weak. Some die from exhaustion, but the younger fish make their way back to the sea. Here they at once begin to feed, and quickly recover their strength. Salmon may breed as many as five times in their lives, but usually only two or three, and they often spend several years in the sea before returning to the river.

Both fresh-run salmon and exhausted kelts, as well as trout, eels and pike, may be caught by that very expert fisherman, the otter. Otters are wanderers and may roam the whole length of a river to the sea and cross miles of dry land to reach another river or lake. They are beautifully formed and are marvellously swift and graceful in the water, where they play as well as hunt. People who have tamed otter cubs say that they grow into the most attractive and affectionate pets. Otters are about chiefly at night, when from the river comes a variety of their strange calls and whistles. Besides fish, they will hunt frogs and shell-fish and on land will feed on any small animals and birds. An otter may eat most of a fish, but often takes only a large bite from the shoulder and leaves the rest on a boulder or the bank.

Should you catch sight of an otter in the water you will see the rather dog-like, broad, flat head, and notice how little disturbance it makes in swimming. If it sees you it will at once dive and swim away under water, rising to breathe with only the top of its nose above water, usually among plants where you will not notice it. If, however, it climbs out on to land, you will see the long, close-furred body, reaching two



SALMON
LEAPING



A graceful swimmer and expert at catching fish, the otter hunts by night. Its home, called a holt, is in a hollow tree or hole in the bank of a stream.

and a half feet in a big dog-otter, and the eighteen-inch-long, thick tail, which is used as a rudder. The footprints are crossed by a waving line, made by the dragged tail.

Otter cubs are born in late winter, blind and helpless, near the water in an underground retreat called the holt. When they first come out, frolicking and furry as puppies, they are afraid of water. But soon they learn to delight in it, and families of otters will play together in the river, and are said even to make slides down a steep mud bank in much the same way as children would.

The patient grey heron fishes in all reaches of the river, and is generally seen with long neck hidden between hunched grey shoulders, its drooping black crest showing clearly, and spear-like yellow beak poised ready for swift and violent action. It stalks forward with slow strides, scarcely rippling the water. Fish, frogs and small land animals are all food for herons. A wildly wriggling eel will smear slime over a heron's plumage, but on its breast are special patches of powder-down. Powder from these is put on the head and neck, and it absorbs the slime. Then, standing on one leg, the heron cleans its feathers with the comb-like edge of its middle claw. If alarmed, the great bird takes off slowly, with a harsh croak. The big, rounded wings span just over a yard, and with gentle flapping but strong flight the heron rises, its head drawn back and legs trailing behind.

EXCITABLE FISH

Few freshwater fish can challenge the size of salmon and pike, and not many remain as small as minnows and sticklebacks, but rivers contain numerous other varieties. Some lived there before man. Others, like carp, were introduced hundreds of years ago from foreign countries for an easy food supply. Monks used to have fish-ponds near their monasteries, and in some of these carp grew to a great age and huge size.

Carp are unexcitable fish, browsing calmly on water-weeds and also eating a few small water creatures. Their relations, the tench, bream, roach and rudd, live in many rivers and lakes. Roach are often caught with a bait of bread paste, and are recognized by their deep bodies and red fins. A very small relation of the carp, the bitterling, is interesting because of its connexion with the freshwater mussel. The fish lays its eggs within the shell of a living mussel, where they do no harm and gain protection while they develop. But the mussel's infants take this chance to cling to the scales of the bitterling with their minute, flapping shells (as they do to newts). They grow right under the fish's skin, and remain until they are able to be independent.

Gudgeon, dace and chub are common in many rivers, but barbel and bleak are found in fewer districts. The vertically striped perch is present in such enormous numbers in some rivers and lakes that in times of shortage of food small perch are taken in tons from Windermere and suchlike places and tinned like sardines.

Lampreys are eel-shaped creatures lower in the animal scale than true fish. They have seven pairs of holes for breathing and no gill-covers. They have no jaws either, but round, sucking mouths. A lamprey holds on to a stone in the river by its mouth, then suddenly wriggles out and attaches itself when a fish swims near. Often that fish is doomed, for the lamprey rasps at its flesh with a toothed tongue and the fish cannot free itself. But in turn many animals, as well as people, eat them.

NO INTEREST IN THEIR EGGS

Most fish show no interest whatever in their eggs. For this reason they must produce vast numbers because so large a proportion of both eggs and small fry are eaten. Pike may lay a million eggs, and many other fish lay several hundred thousand each season.

Since fish grow at very different rates, it is impossible to tell their age by size, but the scales grow with the fish, and examination of a scale can often be an accurate guide. Just as rings of growth show on a felled tree-trunk, so the passing of the seasons is visible on a scale. If a salmon-scale, for instance, is pulled out from the little skin pocket in which it grows and is looked at under a microscope, slightly ridged rings will be seen on its surface. In some places these are far apart, then several will be pressed closely together, forming a dark band, followed again by the wider spacing. The broad rings are made in summer, when the fish is feeding plentifully, and the dark close-ringed band represents winter, when food scarcity allows only a very little growth. So each broad and narrow pair of zones stands for one year in the fish's life.

In some fish-scales this is much easier to see than in others. Eels' scales are very difficult, for they are minute, and the eel may live four or five years in fresh water before it forms its scales. In the salmon one or two curiously irregular rings may be noticed. Each of these represents a time when the salmon returned to the river to breed. During these months of fasting the scale grew frayed and worn. When it went down to the sea and began feeding again the new scale-growth started around an uneven edge.

The third region of the river is the estuary, where the waters ebb and flow with the tide. Small rivers may be hardly any wider where they pass into the sea, but often, as in the Thames, Forth, Clyde and Severn, there are many miles where high tide shows a broad stretch of water and low tide reveals the river's deep channel, running between great stretches of mud or sandbanks. The water will be sometimes more salt, sometimes fairly fresh, so that any animal or plant living here must be able to tolerate both.

Some seaweeds can grow in these conditions, and the eel-grass known as zostera may stretch its long green ribbons over wide areas. The sand and mud flats provide homes for many animals, particularly millions of worms and shellfish. As the tide begins to ebb, flocks of wading birds will follow it down—long-beaked curlews, oyster-catchers and redshanks, and hosts of little waders with mud-probing bills, long legs and broad-spreading toes hunt for their food. Cormorants and gulls fly in from the sea, and duck swim offshore.

The young stages of the mayfly which provide such enjoyment for trout are very common in many rivers. There are numerous different kinds, some flattened under stones, others living in U-shaped burrows in the mud, while some are free-swimming. Most have three long projections at the tail and a double row of rapidly moving gills along their backs. When each larva has grown and moulted many times it is ready to emerge. From the surface a delicate, pale-winged insect flutters up to a branch and rests. But this is not the end, for this green drake (as anglers call one common type) itself splits down its back. From its needle-thin legs the mayfly at last draws out even more slender limbs, from the fine wing-cases even finer, gauzy wings. It rests a little while,

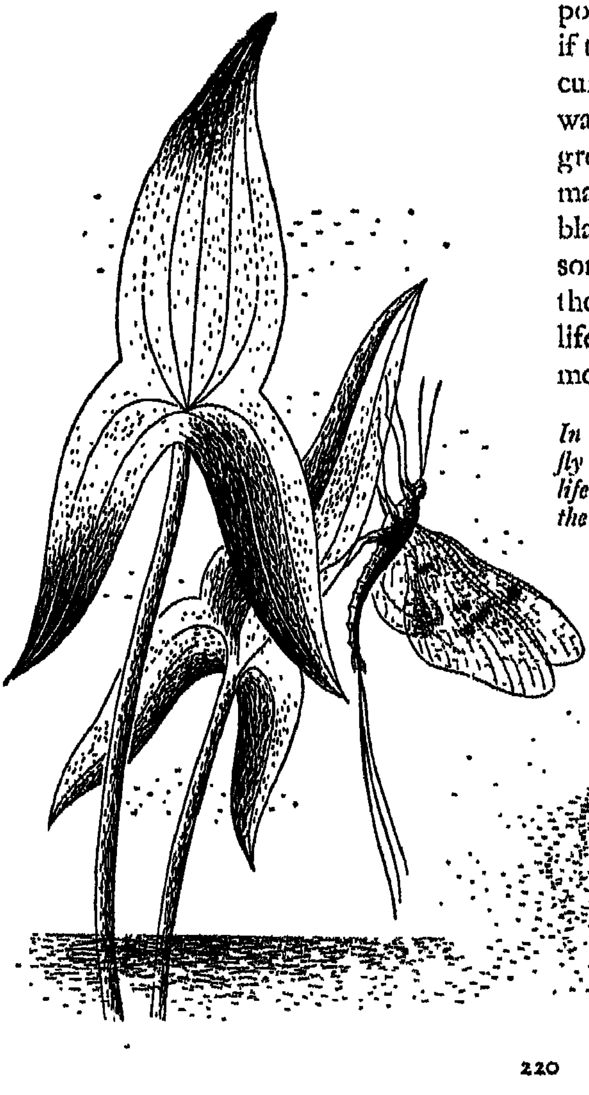
Motionless in shallow water stands the heron. If fish, frog, or water vole swims by, the heron stabs down its long yellow bill and has a meal.

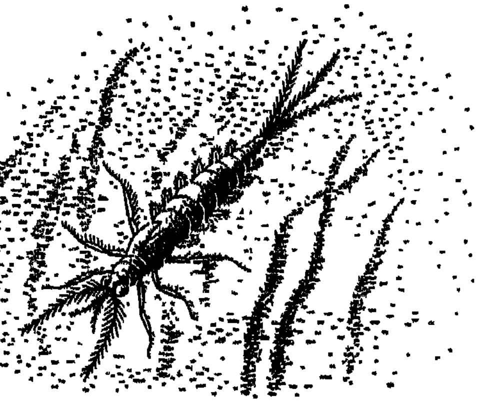
and can be recognized by the two long tail-processes at the hind end.

This grey drake, which has taken possibly three years to form, will have a brief life of only a few hours. It does not feed—and cannot, for it has no mouth. With its kind it will hover over the waters, rising and falling, and after the eggs have been laid on the surface the beautiful insects, dying off, will sink. Some will be swirled away in the current, and many will fall into the mouths of fish eagerly awaiting a meal. But from their eggs sufficient will avoid all perils to make certain that there will be a hatch of mayflies two or three seasons hence.

When the tide flows up the river many fish enter the estuary with it. Eels and flounders live in the part between salt and fresh water, known as brackish waters, but shoals of herring and mackerel follow the tide. Following the shoals of fish often comes a shoal of porpoises. These smallest whales look as if they were playing sea-serpents as they curve their dark bodies in and out of the water in single file. Pilot whales and great basking sharks thirty feet long may enter big estuaries, their triangular black fins showing above water, and sometimes seals come up, too. But with these animals the river is meeting the life of the ocean, and soon its waters merge with the sea.

In its early stages the larva (BELOW) *of the may-fly grows rapidly and sheds skin after skin. The life of the adult insect is short and, hovering over the surface of the water, it soon falls exhausted, a welcome meal for waiting fish.*





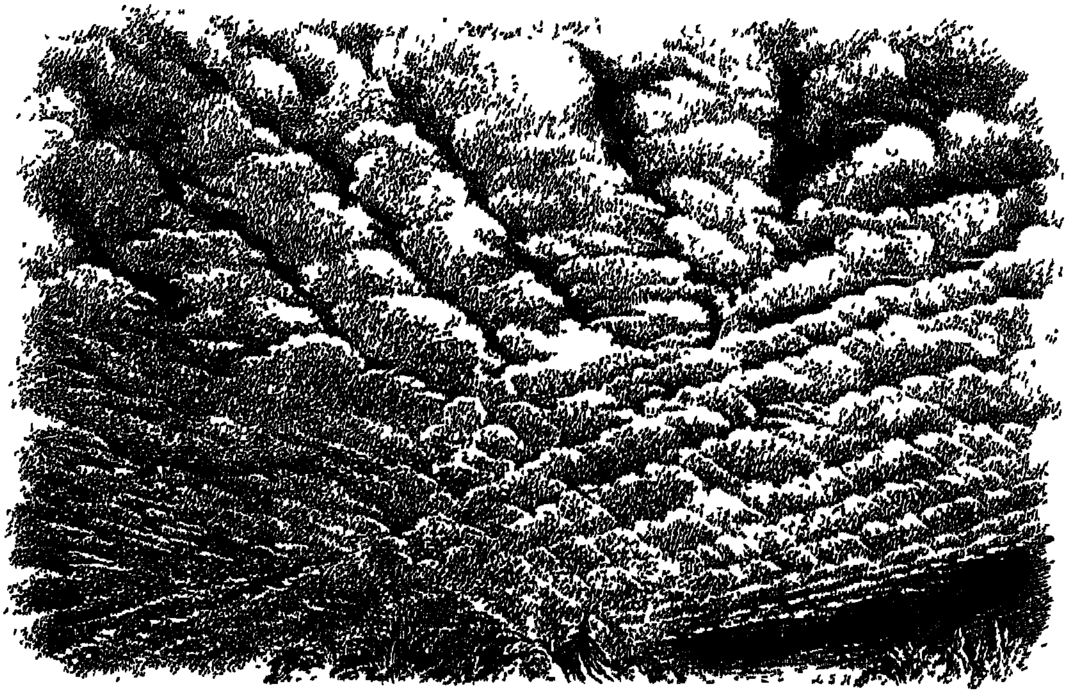
How clouds foretell weather

HAVE YOU ever listened to the full-scale weather forecasts on the radio? If you have you must have been struck by the amount of detail which is put into them and the difference in forecasts for different parts of the country. If you listen often you have probably noticed that the weather men are not always right. The weather tomorrow does not turn out to be exactly what they say it will be.

In fact, the subject of "tomorrow's weather" is still being studied, and the forecasts are gradually becoming more accurate.

But until the time comes when weather forecasts are reliable you can often forecast the weather for yourself a few hours ahead just as accurately as the weather men at the meteorological office. They have to think twelve or twenty-four hours ahead, whereas generally you need only to know what the weather will be for the next few hours. That makes all the difference, because most of Britain's weather comes from the Atlantic Ocean, and a rain area, for instance, may sweep across the country in a few hours, though there is no sign of it at the time when the weather men make their forecast. But however quickly the rain arrives, if you know what to look for you can usually see it coming some time before it begins to fall. In this chapter we are going to look at the sky together and try to learn how to recognize the signs which foretell any particular kind of weather.

Country people are usually very good at forecasting weather. This is partly because they have to be, since so much country work is dependent upon the weather, and partly because they are born and bred in an atmosphere where they can constantly see the sky and come to recognize certain types of cloud without really being aware that they are making a forecast. Very often in towns it is difficult to see the sky because a great deal of haze and smoke gets between you and the clouds. If you live in a big town you must first find some fairly clear space where, even if you cannot see the horizon, you can at least see a good deal of the sky, so that you can



Alto-cumulus cloud, shown above, sometimes persists for long periods in the winter months. It occurs when there is a spell of fine settled weather and is often accompanied by a light easterly wind.

know not only what clouds are overhead but what the clouds look like in the distance.

You must have noticed that clouds are not all of an even texture. Some of them have soft edges and a fuzzy look. Some are light grey in colour, almost white. Others are as black as ink. Some seem to scud across the sky so quickly that you can see them for only a minute or two, while others seem to stand still for an hour or more, perhaps changing their shape a little, but staying in much the same place.

This difference in apparent speed is, of course, partly due to the speed of the wind which blows them across the sky. When there is a high wind you would naturally expect the clouds to move more quickly across the heavens. On the other hand, on quiet days when the smoke rises almost straight up from the chimneys you would expect the clouds to stand still, but if you observe carefully you will find that this is not always the case. Sometimes there will be a swift wind blowing and yet the clouds will be apparently moving very slowly. At another time, though less frequently, when the breeze is light the clouds will be moving quite quickly up toward the zenith, as the part of the sky immediately over your head is called.

Perhaps you find that puzzling. Indeed, there is no explanation for it unless you remember that the nearer you are to a moving object the quicker it seems to move and, conversely, that the farther away you are from something the slower it seems to be going.

So here is a golden rule for looking at clouds. The lower the clouds, the faster they will seem to be moving in relation to the strength of the wind that drives them; the higher they are, the more slowly they will seem to be passing over the sky. In this way you will gradually begin to distinguish between high clouds and low clouds, and be able to estimate very roughly at what sort of height they are floating—a vital one for forecasting future weather.

The very lowest clouds almost touch the ground. In fact, they sometimes do at sea-level, though then they are generally called sea fog. But it is quite common for the tops of hills five or six hundred feet high to be enveloped by cloud, and the average kind of rain cloud is generally not more than a thousand feet up. At the other end of the scale, high clouds can quite often rise to twenty-five thousand feet and sometimes a good deal higher than that.

One reason why it is so important to distinguish between high and low clouds is that when there are only high clouds in the sky rain is not very likely to fall for some time. Low clouds nearly always form before the rain begins to fall. Sometimes it falls from low clouds alone, but when there is a mixture of

The cumulus cloud in the centre is the cloud heap which is often seen on a normal summer day. Below it is a layer of dark nimbus; the combination of these two cloud forms often means a thunderstorm. The rainbow shows that another rain cloud has just passed overhead, so the indications are that the weather will be showery with heavy rain at times.

high and low clouds, and the low clouds seem to form as if by magic underneath the high ones, then rain is imminent and is likely to last a long time.

The most common kind of cloud that comes before or with rain is called the nimbus. It has a ragged edge and scuds rapidly across the sky, constantly changing its shape and is closely pursued by others of its kind. More often than not it comes with a wind from the south-west. When rain begins to fall from this kind of cloud with a wind between south and west it will probably go on raining for three or four hours, occasionally longer. Then gradually you will see the texture of the clouds changing, the nimbus clouds begin to disappear and a much higher cloud, often showing patches of blue, takes their place. The wind, too, generally changes its direction and begins to blow from the west or north-west. Then you will know that the rain is over, though there may be a few showers later on.

LOW CLOUDS

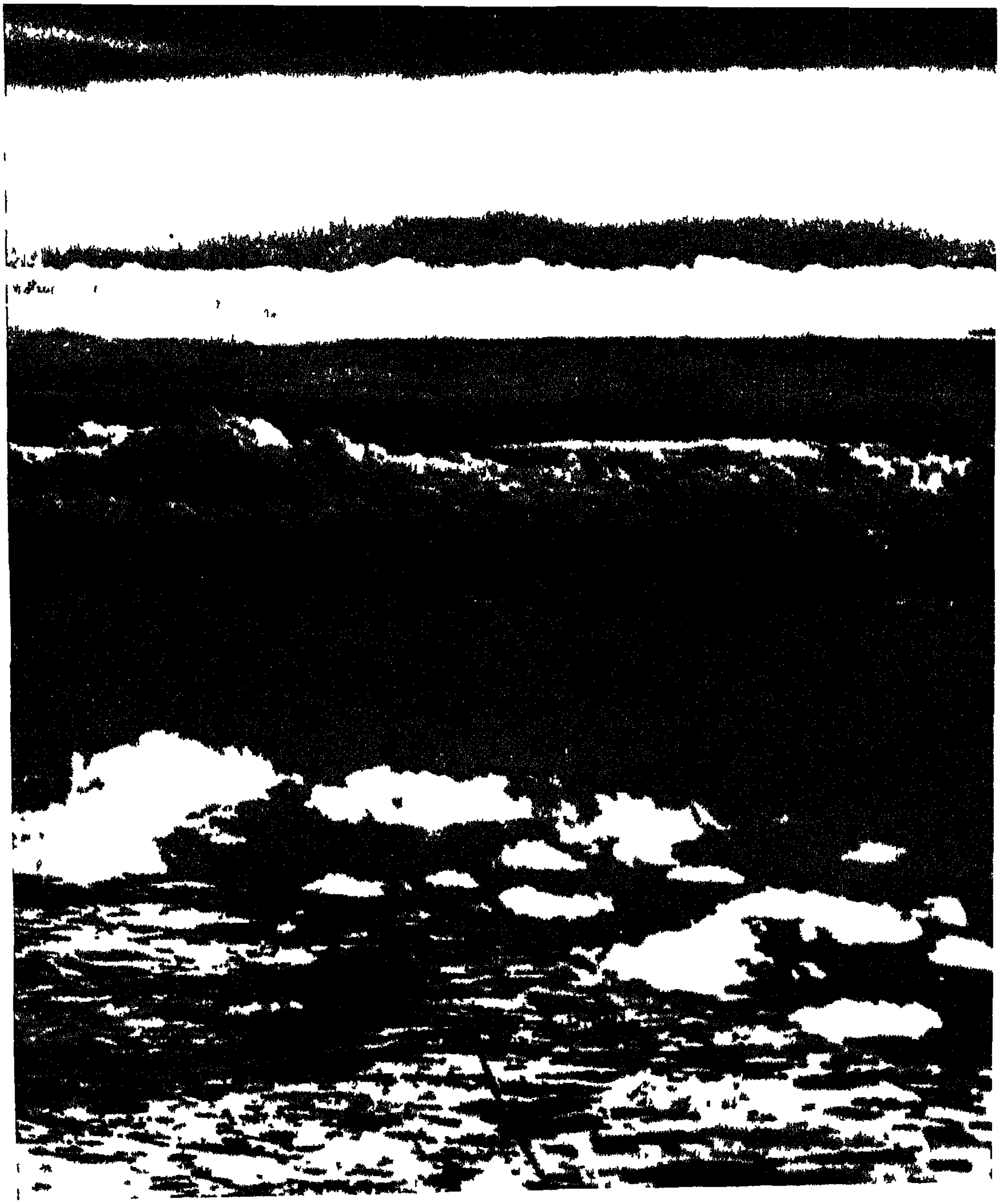
Another kind of fairly low cloud which you must look for is the stratus cloud. Stratus is a Latin word meaning something laid flat like a sheet. A stratus cloud is very like a sheet of even texture, slow-moving, at any height up to six thousand feet, but more often than not about three thousand feet above the ground. Ground fog is actually a kind of stratus with its lower edge touching the ground.

You may have been on a hilltop in foggy weather above the fog bank and looked down on it. If you have, you will have seen the sharp, clearly defined edge between the fog bank and the clear air above, where you can usually see a very long way and perhaps pick out the peaks of distant hills across the fog. That is because there is very little moisture or dust in the atmosphere above the fog. The same is true of stratus cloud proper. It is a thin even sheet of cloud and usually comes with fine weather. In winter especially, the sky is often covered with stratus for days on end and when it is you can be quite sure that the dry weather will continue for a time.

RAIN CLOUDS

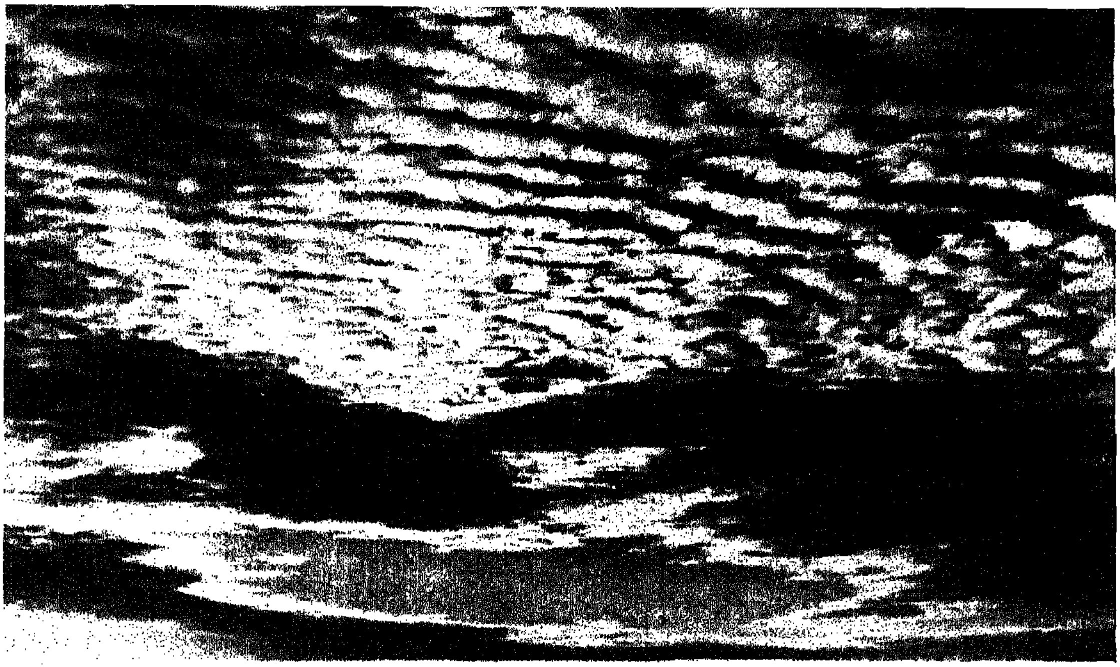
Next look for some of the higher clouds. The first of these to identify is the alto-stratus. That only means a high layer of stratus, but because the layer is much farther from you than the ordinary stratus cloud you cannot distinguish its texture and it looks like a solid grey veil stretching over the whole sky. Very often you will see lines across it roughly parallel with each other. This kind of cloud in temperate regions is the forerunner of rain. Do not be misled, even if you see the sun shining through it. You will find in an hour or two that the sun will disappear and the rain will begin to fall. Generally when rain does begin, the low scudding nimbus will also make its appearance and blot out the alto-stratus from view, but this is hours after the first appearance of the veil-like high cloud. If you see this in the morning you will nearly always need your raincoat by the afternoon.

The third group which you must distinguish is at a still higher level, be-



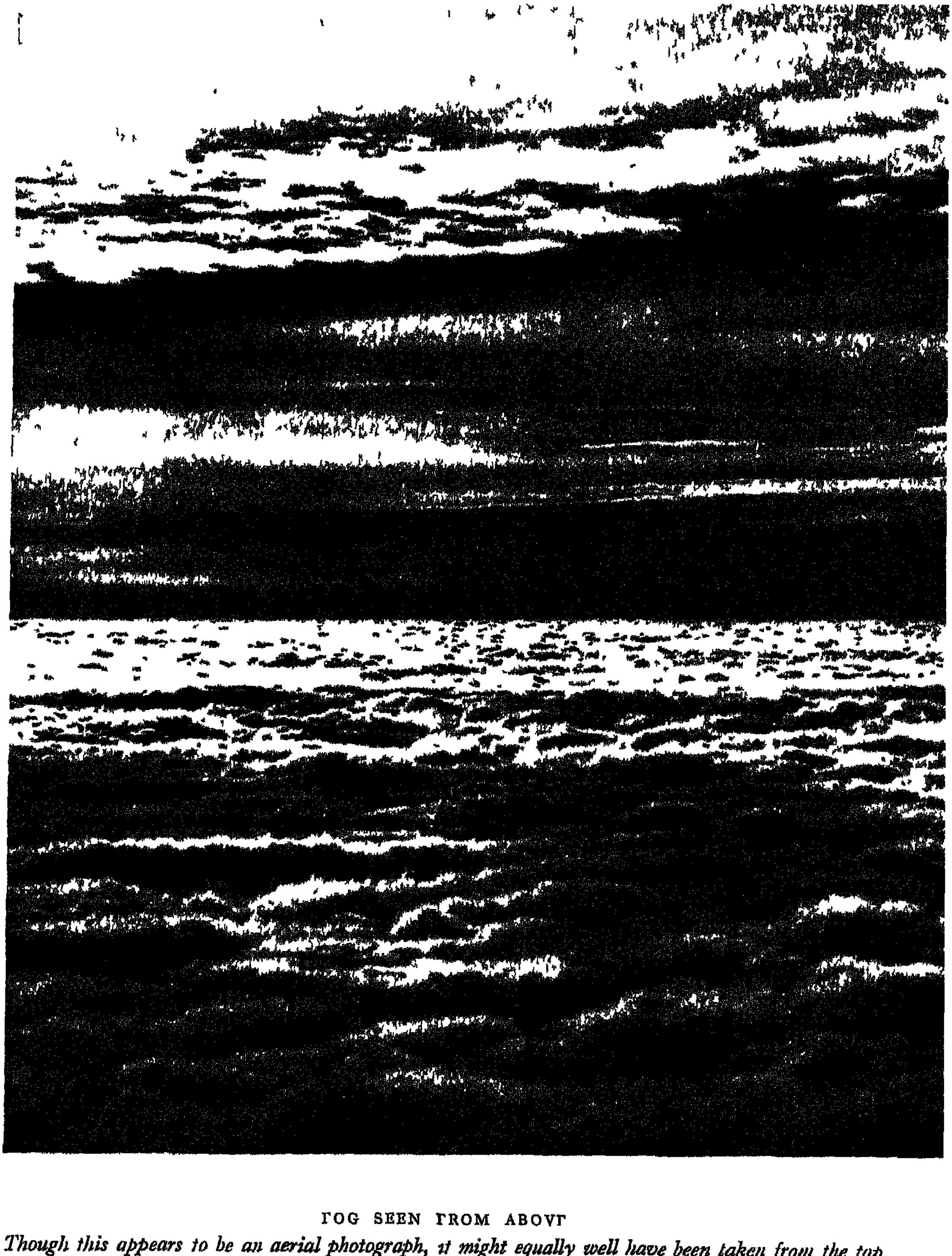
A RETREATING RAIN FRONT

This aerial photograph was taken at a great height over southern England looking across the English Channel to the coast of France. Many of the chief types of cloud are shown. In the foreground are fair-weather cumulus clouds rising over the heated land: note that they do not occur above the sea. In the middle distance over the coastal areas of France are heavier cumulus clouds from which rain showers emanate. In the far distance are cirrus, alto-stratus and other clouds.



STRATUS AND CIRRUS CLOUDS

Above is a sheet of stratus (layer-like cloud) which occurs in this broken form generally in fine weather systems, particularly in winter. It has great persistence and may last for several days on end. The clouds shown below are cirrus and are rather thick for this type of cloud. Normally cirrus occurs on the edge of fine weather systems and is the first sign of an approaching depression or front. In this case the cirrus is so thick and complex that it forecasts rain in the comparatively near future.



FOG SEEN FROM ABOVE

Though this appears to be an aerial photograph, it might equally well have been taken from the top of a hill in foggy weather. It shows a layer of stratus cloud below and various high clouds, including alto-stratus and some cirrus above. Note the particularly level top of the stratus cloud which well illustrates its name "layer." Fog is a form of stratus cloud touching the ground.

STORM CLOUDS

Many of the most spectacular cloud shapes are formed from cumulus, a swelling, mushroom-like cloud which can tower to great heights Beautiful though this cloud looks, it does not promise good weather, the dark mass of nimbus beneath it foretells rain, and the combination of these cloud forms means that a thunderstorm is probable in the near future tween twenty and thirty thousand feet above the earth. This group is called cirrus, another Latin word which means a tuft or curl. You will quickly be able to distinguish them just by thinking of the meaning of the name, for cirrus clouds look like detached tufts of curly hair spread irregularly over the dome of the heavens. You will find by experience that you will see these clouds more often toward the end of a spell of settled fine weather. If so, it is a sign that the weather is breaking up and that rain will follow in a day or two. If the number of the tufts increases rapidly it is a certain sign that bad weather is approaching and you will find they are soon followed by the veil-like solid covering of the sky which, as we have seen, is called alto-stratus.

SHOWERS AND STORMS

All the clouds we have talked about so far are said to have an horizontal development, that is to say, they are more or less in layers and to the observer on the ground do not seem to move up or down. But there is another kind of cloud which has a vertical development. Instead of spreading across the sky it develops upward. This kind of cloud is called cumulus, which is the Latin word for a heap. The effect these clouds give as they develop is of mounting up into the sky, with a wonderfully clearly defined edge toward the zenith and a more ragged edge toward the horizon. They are a sign that there are strong up-currents in the atmosphere, which means that the atmosphere is unstable. If the development is very strong, showers will quickly follow and in summer you must expect thunderstorms.

Sometimes when you are looking for this kind of cloud forming on a fine summer's afternoon you will find that instead of developing strongly they tend to fade away, scarcely changing their position at all, until they have disappeared. That is a sign of continued fine weather. Sometimes, too, when they have appeared quite thickly you will see the tops flatten out toward sunset and the sky clear as if by magic. Then you can be fairly sure that tomorrow will be fine.

RED SKIES

There are other signs in the sky besides clouds to help you. For instance, a halo round the sun generally means unsettled weather on the way. A red sky at night usually means a fine day tomorrow, but a red sky in the morning is often followed by rain. That is because weather in the northern hemisphere most often moves from west to east. If the sky is red at sunset it means that the clouds are given their rosy hue by the sun in a clear sky near the horizon in the west. So what the red sky really tells you is that there is clear weather coming up. If the sky is red before sunrise it means that the sun is shining below the horizon in a clear sky and there are clouds coming up from the west.

So here is one last rule for watching the weather. See which way the clouds are moving and then look at that part of the horizon from which they are coming. It will frequently give you an idea of the clouds which will be overhead later on.

On the seashore

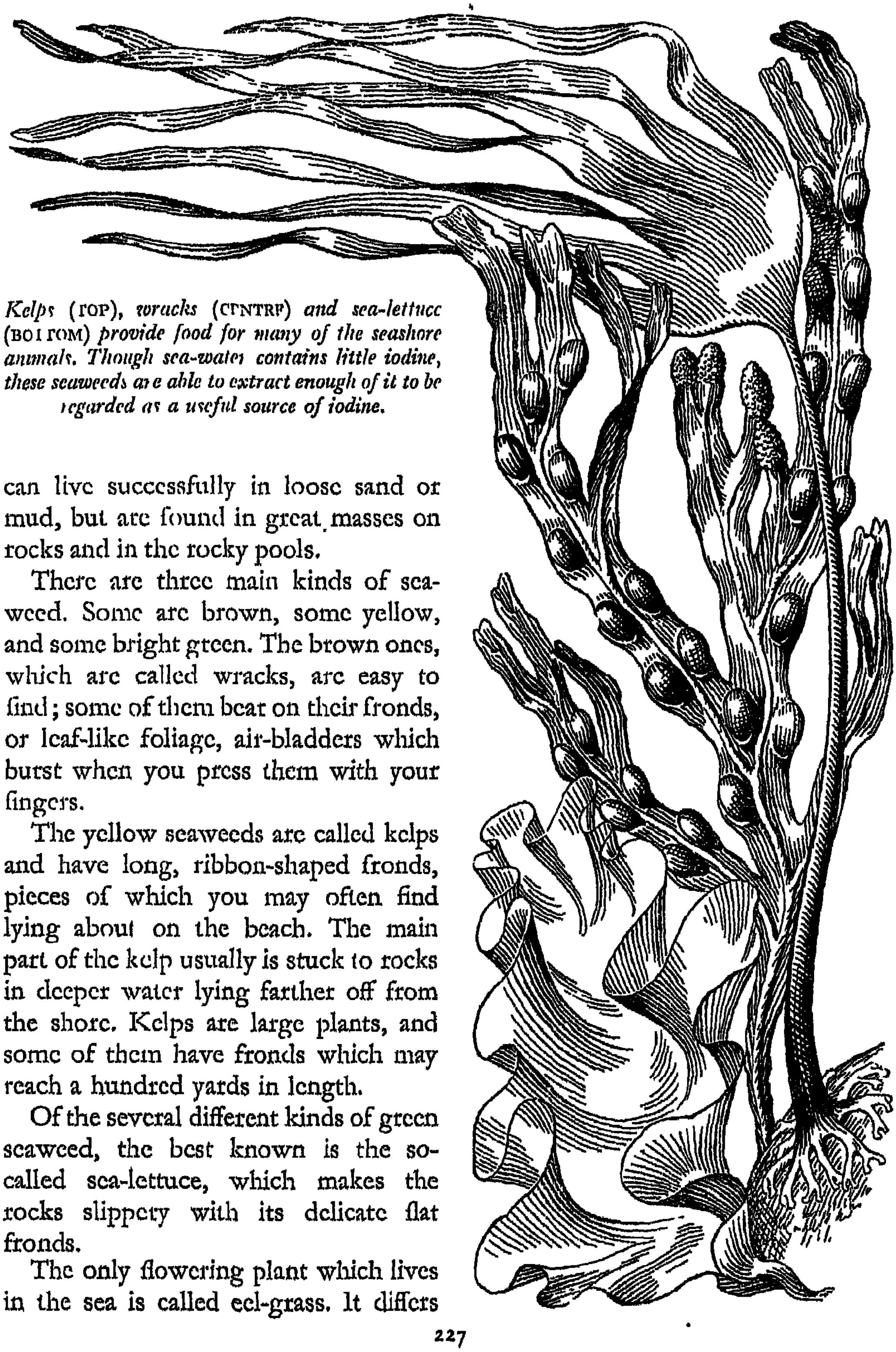
In the strange conditions that exist on beaches, whether pebble or sand, many plants and animals thrive. Above high-water mark, among the dry but salty sand and stones, may be found marram grass, saltwort, sea-holly, thrift, and other plants. A strange collection of plants and animals, however, lives between the tidemarks.

Conditions here are far from easy. Twice a day, every day, the sea retreats, leaving the beach uncovered and the creatures on it without the protection of the water. Twice a day the sea advances, with wavelets lapping, or if the weather is bad, with huge waves crashing down and pounding on the beach. Buffeting by even small waves can be a rough experience for the tiny creatures of the beach.

In the storms of winter towering sea waves rush toward the land. The sea-floor, shallowing as it nears the beach, causes the waves to roll and topple; as they fall headlong they break on the shore. When these great breakers rush against the shore it is as though giant hammers were pounding on the cliffs. The force of the blows may be as much as two tons on each square foot of cliff face. No wonder that after a storm we find great boulders torn from the cliffs and scattered on the beach.

When the next storm comes the surging waves fling the stones and boulders at the cliffs from which they fell; under the weight of this artillery attack more of the cliff face crumbles and crashes down. So at each successive storm more and more damage is done. Although where the cliffs are hard and strong they wear away only slowly, where they are of softer rock they may lose several yards every year. In this way the cliffs are mown down into the sea. The rocks, pebbles, and sand at the cliff foot deposited there by the pounding of the sea are the materials which form the various parts of the shore.

In a world where so much change is constantly taking place there is always a risk that seashore animals and plants will be swept away either by tides and currents of the sea or through the pounding of waves during storms. For this reason many of the animals have devices which help them to hold on to their positions. The plants, too, most of which are seaweeds, instead of having roots, as do land plants, are attached by suckers to any solid objects in the water. Because they have no roots few seaweeds



Kelps (TOP), *wracks* (CENTRE) *and sea-lettuce* (BOTTOM) *provide food for many of the seashore animals. Though sea-water contains little iodine, these seaweeds are able to extract enough of it to be regarded as a useful source of iodine.*

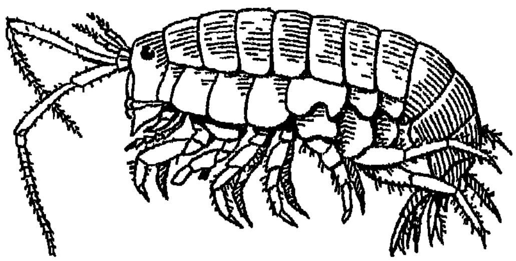
can live successfully in loose sand or mud, but are found in great masses on rocks and in the rocky pools.

There are three main kinds of seaweed. Some are brown, some yellow, and some bright green. The brown ones, which are called wracks, are easy to find; some of them bear on their fronds, or leaf-like foliage, air-bladders which burst when you press them with your fingers.

The yellow seaweeds are called kelps and have long, ribbon-shaped fronds, pieces of which you may often find lying about on the beach. The main part of the kelp usually is stuck to rocks in deeper water lying farther off from the shore. Kelps are large plants, and some of them have fronds which may reach a hundred yards in length.

Of the several different kinds of green seaweed, the best known is the so-called sea-lettuce, which makes the rocks slippery with its delicate flat fronds.

The only flowering plant which lives in the sea is called eel-grass. It differs



Though sand-hoppers live on land they are more closely related to shrimps and prawns, and they live among the damp rotting seaweed from which they gather most of their food.

from all the seaweeds because, in addition to its flowers, it also has roots, and so can live on the muddy sea-floor in shallow water, where sometimes it forms huge banks. The flowers of eel-grass have pollen grains which can float at any level in sea-water, and because of this they can be pollinated even when covered by the sea.

All the sea plants, even the brown and yellow seaweeds, contain the green substance, called chlorophyll, which enables them to make food from the minerals and gases in the sea-water. They grow larger on this food, and, just as growing plants on land provide food for animals which graze on them, so these sea plants provide food for some of the sea animals.

The sea animals that browse on the seaweeds have to protect themselves from being stranded when the tide goes out. Some, like the sand-hoppers, keep themselves from drying up by hiding in the damp seaweed thrown up by the waves.

Sand-hoppers are interesting creatures because, like fish, they breathe by gills, but also leap through the air like land animals. In the heaps of stranded seaweed may be found millions of these tiny creatures. Their main aim seems to be to eat as much as they can. This is just as well, because they act as scavengers, clearing away the weed that otherwise would rot in the hot summer weather. In this way they do much good, though some of them, which have habits rather less endearing to us, are known as beach-fleas.

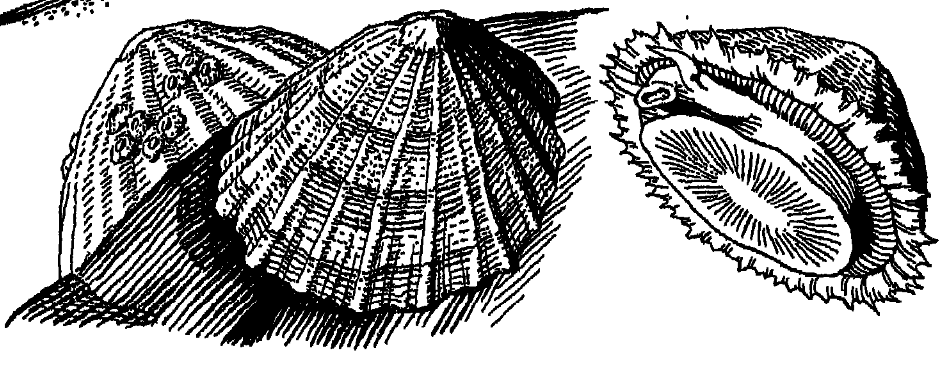
When the tide goes out it is not only the sand-hoppers which must seek means to protect themselves from drying up. This danger has to be overcome by most of the animals which live on the beaches, and there are several different ways in which they do it. A few creatures are found usually under the damp stones of a pebble beach; others live in the wet sand-flats; some seal themselves up with water in their homes, but many more are to be found in the pools among the rocks.

These pools, therefore, are the best places in which to search for seashore animals. Here you can easily find the common animals, such as mussels, crabs, periwinkles, and shrimps. In your search you will encounter many surprises. There are animals which look like flowers, and their colours are very lovely; other animals have such frail bodies that if they are left stranded out of the sea for only a short time they melt away into the air; and some there are with very strange ways of feeding and growing.

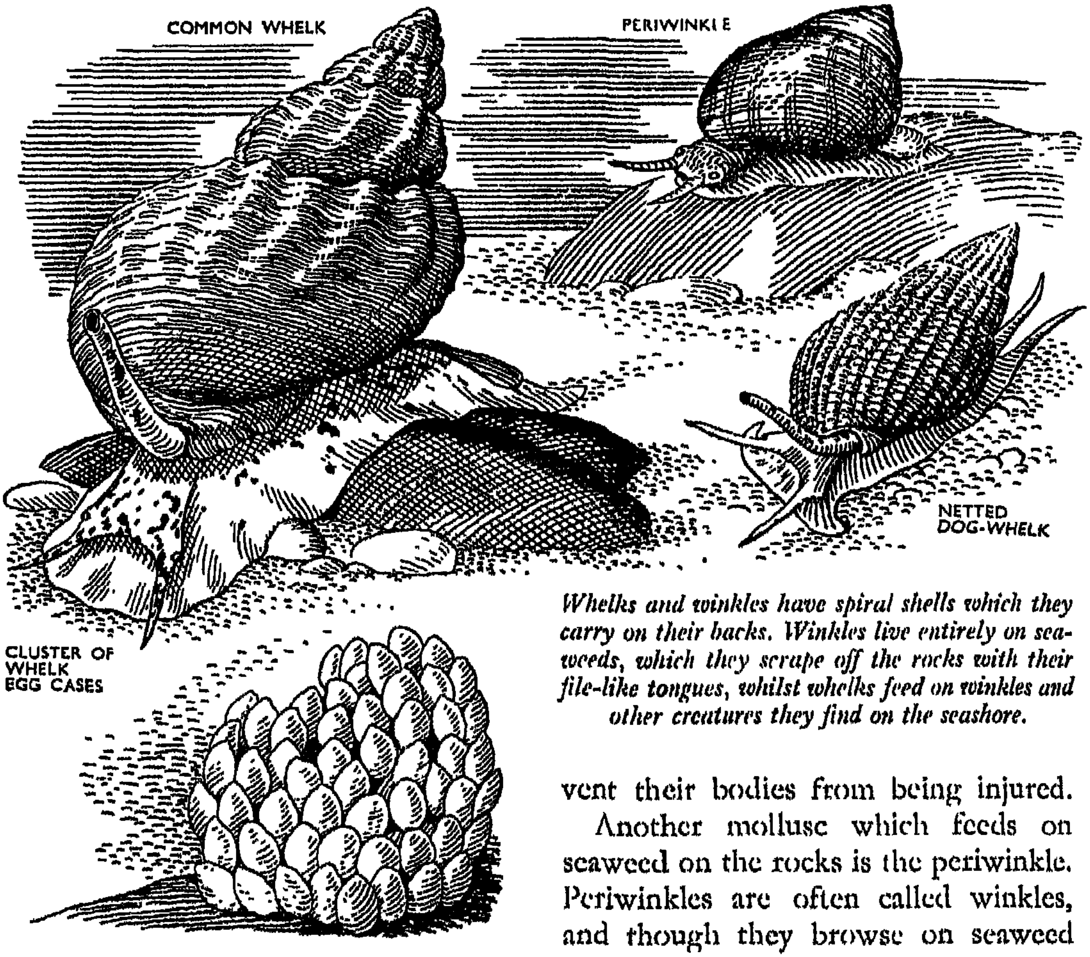
As you search for the most likely looking pool you will probably see on the rocks some of the limpets which browse on the seaweeds that grow there. They protect their soft bodies from the waves with their hard dome-shaped shells. The shell is really the animal's skeleton as well as its home. When the tide goes out, the limpet stores enough water in the shell to last it until the tide flows back again. When the tide is in, the limpet strolls around under water, browsing on the seaweeds. But it is a great home-lover, and always returns to its place on the rock before the ebbing waters have fallen too low.

Because the limpet always returns to exactly the same place, the creature's slowly growing shell becomes moulded to the rocky surface, and the rock itself becomes slightly hollowed out under the limpet's foot. Because its shell fits so neatly to the rock on which it sits, the limpet can clench down to grip the rock tightly if you try to pick it off. But unless it thinks there is danger near, the limpet leaves a small gap between its shell and the rock, so if you want to get the limpet off the rock you must gently slip a knife-blade between the edge of the shell and the rock. When you have done this, the limpet will come off easily and you will be able to see that it has a large fleshy foot with which it attaches itself to the rock.

In the springtime the limpet lays eggs which soon hatch into tiny transparent animals which look very unlike limpets. Each one has a girdle of living



Mussels and limpets live attached to rocks. The mussel (TOP) *is holding on by bunches of sticky bristles, but is also able to move about on its foot seen in the centre drawing. The limpet* (BELOW) *has a flat foot which grips the rock like a sucker; this it also uses for moving about when the water covers it. Inside their shells mussels and limpets have soft bodies without any joints. Creatures of this kind are known as molluscs.*



Whelks and winkles have spiral shells which they carry on their backs. Winkles live entirely on seaweeds, which they scrape off the rocks with their file-like tongues, whilst whelks feed on winkles and other creatures they find on the seashore.

lashes which wave about, rowing it through the water. Many of these little animals are eaten by larger creatures, but some manage to settle down, grow a shell and a foot and become grown-up limpets.

When the young of any animal is different from its parent, as the limpet is, we call it a larva, and many seashore animals have swimming larvæ of this kind.

Limpets have soft bodies and creep about on a soft fleshy foot. Animals of this kind are called molluscs; most molluscs have shells of some kind to prevent their bodies from being injured.

Another mollusc which feeds on seaweed on the rocks is the periwinkle. Periwinkles are often called winkles, and though they browse on seaweed in the same way as do limpets, they do not have the same homing instinct. The winkle-shell is twisted into a spiral, and on its foot the winkle has a little round, horny door which it shuts tightly when it draws the foot inside the shell. This protects it from drying up when the tide goes out.

Winkles have long tongues which bear rows of tiny sharp teeth, and as they crawl over the rocks they use the tongue as a rasp, scraping off weed on which they feed. This rough treatment wears away the tongue, but that does not worry the winkle, which grows more to replace that which is worn away by scraping.

Just as limpets and winkles feed on seaweed, so do other animals feed on limpets and winkles. One of the most serious of their many enemies is another mollusc, the whelk. The whelk has a spiral shell like the winkle's, but is larger. Though they may be found on the rocks of the seashore, the whelks spend a good deal of time in the deeper water off-shore.

ANIMALS WHICH EAT EACH OTHER

Whelks are called carnivorous molluscs because they feed on other animals. When a whelk feels hungry it creeps up on a winkle or other small mollusc and with its powerful rasping tongue bores a hole in its shell. Then it sucks the poor animal out, leaving the empty shell behind.

Not only are the whelks ruthless in the way they feed when they are grown up, but even as youngsters they show little consideration for others. Many people have seen the clusters of empty whelk egg-cases on the beach and have probably wondered what they are. In each cluster there are several dozen of these yellow, papery egg-cases. The young whelks which hatch first from each cluster at once gobble up their slower brothers and sisters. In this way perhaps as few as half a dozen sturdy little whelks finally creep out from the mass of egg-cases.

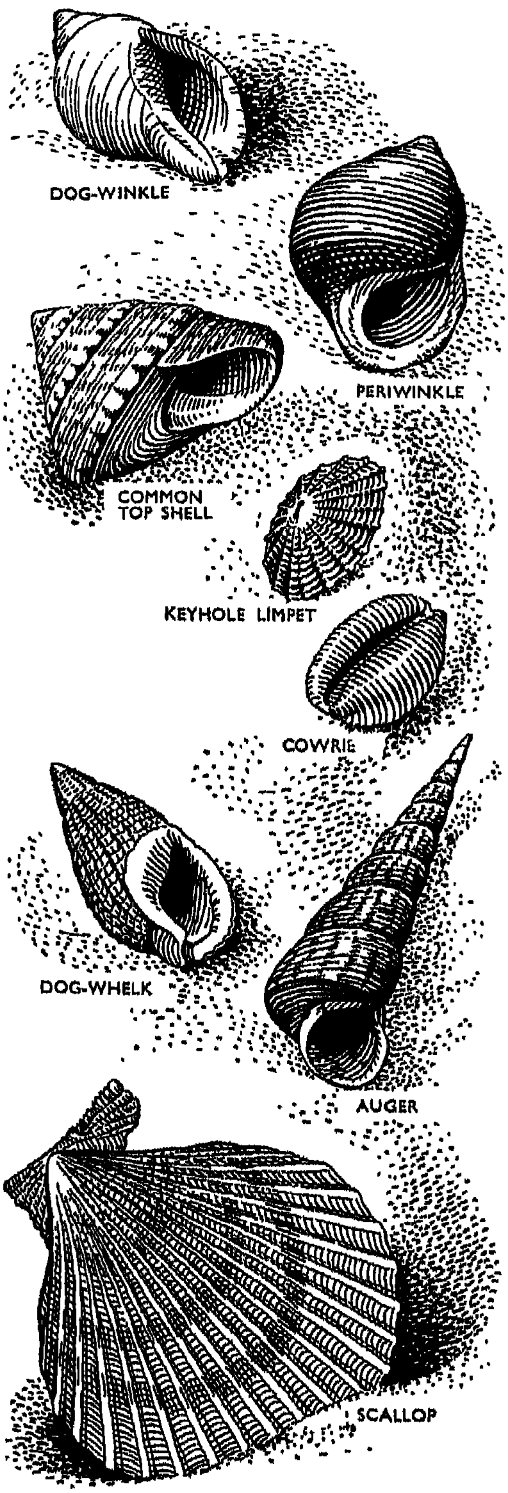
The common whelk, or buckie, is almost the largest mollusc you will find, but there are always plenty of empty shells of others lying about. There are, for instance, dog-whelks, dog-winkles, top-shells and cowries: not to mention the shell of the slipper limpet, which makes itself a nuisance in oyster-beds by eating oysters in the same way as whelks eat winkles. Some of the mollusc-shells are brightly coloured, and a collection of them can be both interesting and beautiful.

As you watch the waves breaking on the shore it is hard to believe that the water is loaded with food. Yet it is. In addition to the minerals in the water, there are floating in it vast quantities of plants so small that fifty of them could lie easily on the full stop at the end of this sentence. These plants are called diatoms, and very beautiful they are when seen under the microscope. These tiny diatoms feed on the minerals in the sea-water just as the seaweeds do.

SEA-SOUP

In the spring of the year many of the sea animals lay their eggs, which, like those of limpets, hatch into tiny swimming larvæ. These larvæ feed on the diatoms, and many of them are eaten in turn by water-fleas. Although the commonest of these water-fleas is barely one-sixteenth of an inch long, it is so numerous that it provides food for even large fish, such as herring, which feed on practically nothing else.

In the springtime, then, in every drop of the sunlit surface waters of the sea there may be hundreds of water-fleas, thousands of larvæ and millions of diatoms, all either eating or being eaten by one another. In fact, at this time of the

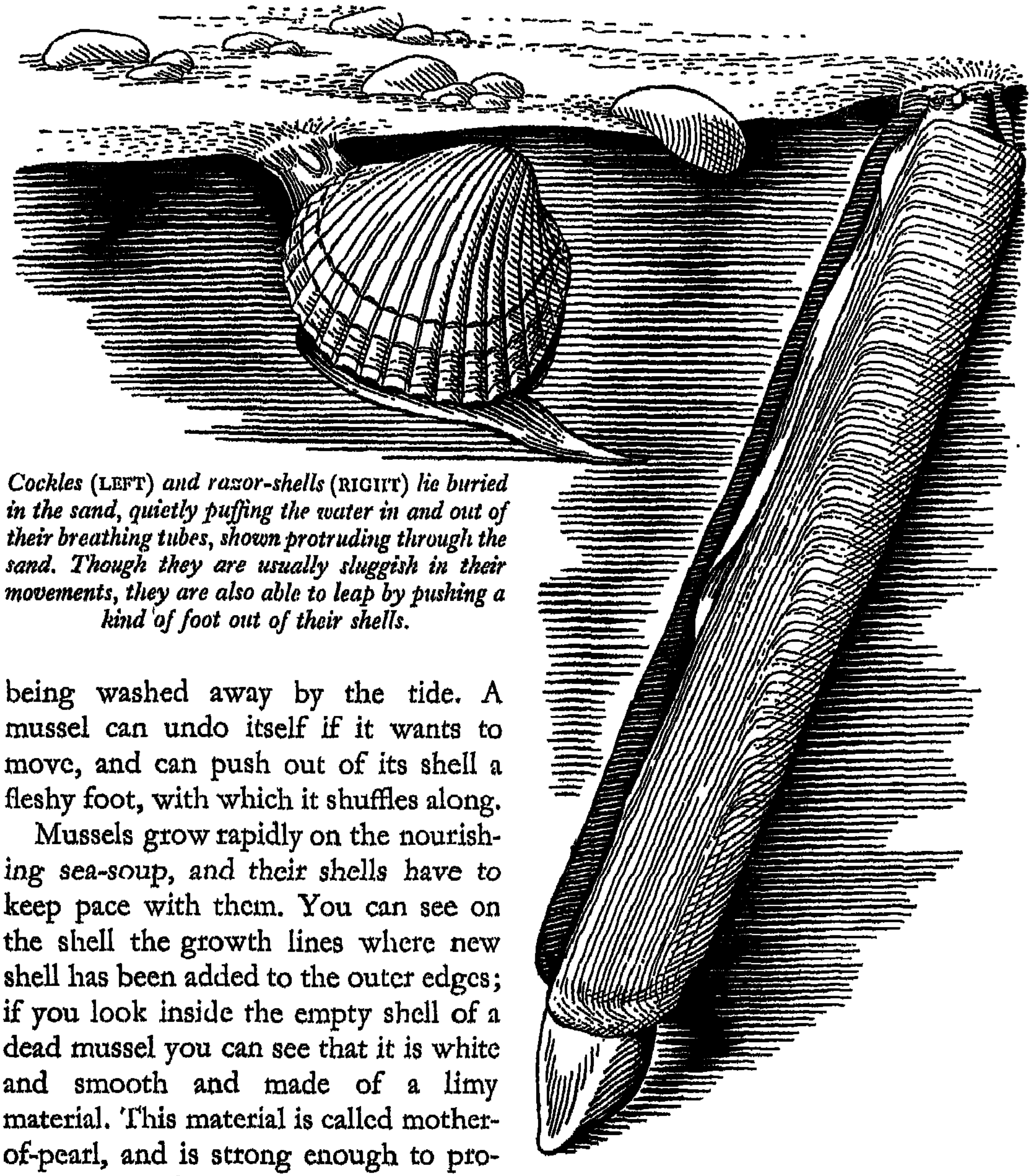


year the sea-water is really a kind of living meat-and-vegetable soup which is very nourishing. Mussels, cockles, and oysters all live on it, so do many sea-worms, and even some fish.

One of the most numerous of the sea-soup drinkers is the common mussel. This animal is a mollusc, but, unlike winkles and whelks, which have only a single shell, its soft body is protected by two equal shells which are joined together by a hinge. These shells are sometimes called valves, and because mussels have two of them they are sometimes called bivalve molluscs.

In rock pools, on breakwaters, piers, and even on ships' hulls, there are colonies of mussels millions strong. If you watch a mussel in the clear water of a rock pool you will see it lying still with its shell slightly open. Protruding from the edges of the shell is a soft, fleshy blanket; because this blanket surrounds the animal's soft body, it is called a mantle. Lying within this mantle, and protected by it, are some delicate gills which are covered with millions of tiny lashes, the constant waving of which draws a stream of water into the shell, from which it flows out again through a fleshy tube.

Small though mussels are, each one passes several gallons of water through its body every day. As the water passes the sticky gills they strain it of its goodness, and the lashes pass the captured food into the mussel's mouth. Mussels, therefore, do not need to move about in order to feed, so they attach themselves to the rocks by bunches of sticky whiskers; this stops them from



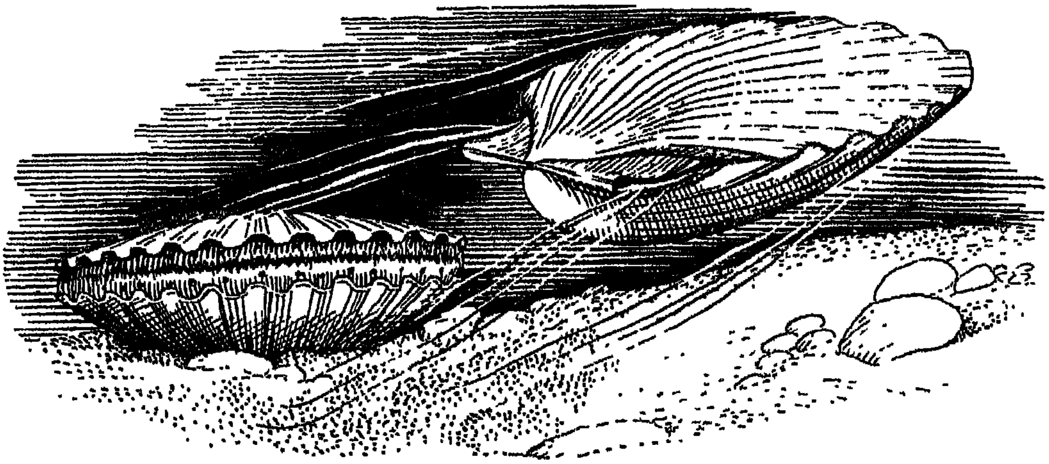
Cockles (LEFT) *and razor-shells* (RIGHT) *lie buried in the sand, quietly puffing the water in and out of their breathing tubes, shown protruding through the sand. Though they are usually sluggish in their movements, they are also able to leap by pushing a kind of foot out of their shells.*

being washed away by the tide. A mussel can undo itself if it wants to move, and can push out of its shell a fleshy foot, with which it shuffles along.

Mussels grow rapidly on the nourishing sea-soup, and their shells have to keep pace with them. You can see on the shell the growth lines where new shell has been added to the outer edges; if you look inside the empty shell of a dead mussel you can see that it is white and smooth and made of a limy material. This material is called mother-of-pearl, and is strong enough to protect the animal even from violent storms.

If you touch a mussel when it is feeding it will quickly clamp its shell shut, taking care to keep a little water within it. In this way it can protect itself from drying up when the tide goes down, but this is no protection from attacks by whelks and other carnivorous molluscs. Nor does it help, as we shall see, when the enemy is a starfish.

Two other bivalve molluscs which live on sea-soup are often very common in the shallow water near the shore. These are cockles and razor-shells. Cockles have white or pale-grey



Scallops lie on the sea floor with their shells slightly apart. They have glittering purple spots scattered around the body which are sensitive to light. Unlike many of the other shelled animals of the sea, they are able to swim by flapping their shells back and forth. When in danger they take a gulp of water and quickly squirt it out. This shoots them backwards by jet propulsion and helps them to escape.

shells which are prettily ribbed, while those of razor-shells are dark, long and narrow, shaped like the old-fashioned razors that give them their name. Both these molluscs spend much of their time buried in the sand, well hidden from their enemies, but with their feeding-tubes poking up into the water. There they lie quietly pulling the water in and out and occasionally heaving gently as they change position slightly. Sometimes they decide on a larger move and, using the fleshy foot as a lever, push themselves over the sand. They use the foot, too, for burrowing into the soft sand when they find a place that suits them. If they dislike their home they can give a powerful kick, flinging themselves up in the water, and float off elsewhere.

This is a good method of travelling about, but the scallop, another bivalve sea-soup drinker, which also lives on the sea-floor, knows a better one. It rests flat on the sandy bottom, and if it finds the soup too clear for its taste it decides to search for a thicker kind elsewhere. Opening its shell it takes a large gulp of water, and then quickly squirts it out. This propels it through the water, and by flapping its shells it flutters to a new feeding-ground.

Unlike many bivalve molluscs, the scallop has unequal shells, for one is flat, while the other is streamlined like the planes of an aircraft. There are not many sea animals that use jet propulsion in this way, but the cuttle is one of them, and later on we shall find out more about him.

Scallops, cockles, mussels, and razor-shells are all able to move about, but oysters are bivalves which can do so only while they are very young. When an oyster lays eggs she pours out millions of them. For a time they stay within the shelter of the mother's shell. Then they hatch and stream out into the water. Oyster-men call this stream of larvæ spat, and although oysters produce immense quantities of spat, very few of the larvæ become fully grown oysters. This is because the tiny transparent oyster larvæ swimming in the water help to make up the meaty part of the sea-soup, and are, therefore, eaten by larger animals.

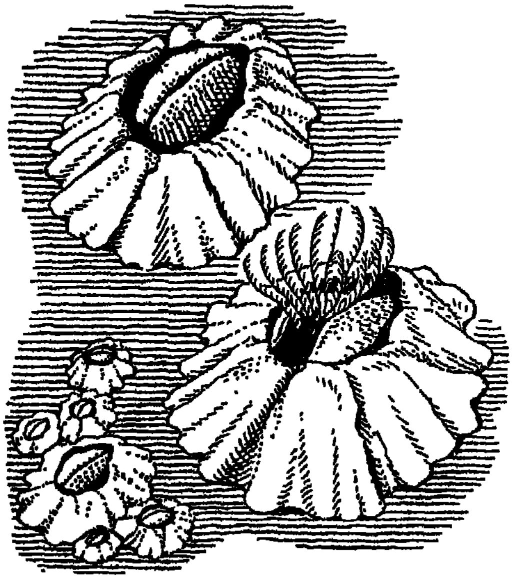
Some of the larvæ, of course, escape, and after a few weeks sink to the sea-floor. If they find a smooth, rocky surface they stick themselves to it, and live and grow on the food that they filter from the water. Once they have settled down they stay where they are for the rest of their lives. This is longer than you might expect, for it takes at least five years before oysters are really large enough to be worth eating, and many an oyster may live as long as ten years.

Molluscs are by no means the only animals that have hard shells. Many sea-worms protect themselves with shelly tubes, and they, too, live on the diatoms and tiny animals in the water.

You probably know two of the commonest of these worms. The smaller one forms a tight white spiral like a miniature catherine-wheel, and is often stuck to the fronds of brown seaweeds. The other is larger, and its limy tube wanders over the surface of the empty mollusc-shell to which it is stuck.

The sand-mason worm does not make limy tubes of this kind, but builds them of sand-grains which are stuck together with thick slime poured out from its skin. These tubes are often quite tough, and can be seen sticking up out of the wet sand at low tide, looking like pale brown, hollow corn-stalks. The sand-mason worms huddle deep down while the tide is out. When the sea comes up and covers them, the worms creep up their tubes and, together with others who have been also hiding in the sand, expand their brightly coloured, feathery feelers.

In addition to all these worms and molluscs, barnacles also feed on the tiny living things in the water. Barnacles are strange animals, for, although they look somewhat like limpets, they are not molluscs. We know from the kind of eggs they lay and the larvæ that hatch from them that they are more closely related to water-fleas. In the spring these larvæ swim about in the water and, after growing for a time, settle on a



Barnacles protect themselves from drying up when the tide goes down by closing their shells. When the water covers it the barnacle (BOTTOM) *opens its shell and pushes open its curly jointed legs.*

rock or empty mollusc-shell. Then the little animal changes its shape, its legs get longer and its head swells, and it becomes quite stuck-up as it pours out the limy substance that hardens and forms the barnacle-shell we know so well.

A NOVEL USE FOR LEGS

You find these barnacles on nearly all solid objects in the sea, and if you look at one you will see that the shell has an opening at the top that can be closed when the animal is out of water. The animals are firmly fixed, and cannot wander about to obtain food. At high tide, when they are submerged, they push out a fringe of long, curly, jointed legs, which they wave about, wafting the sea-soup into their mouths. No molluscs have legs of that kind, so these legs are a sign that barnacles belong to the same group of animals as water-fleas, crabs, and lobsters.

A barnacle's life must be rather dull, for not only is it fixed to one place for life, but it can neither see nor hear, and probably can neither taste nor smell. As the famous scientist, Thomas Huxley, said, barnacles live lying on their backs, kicking their food into their mouths. When the tide goes out many of them are uncovered, and are, therefore, not only unable to feed, but have to protect themselves from drying up by closing the hole in the shell.

There may be so many barnacles that they form a solid crust completely covering the rock on which they live.

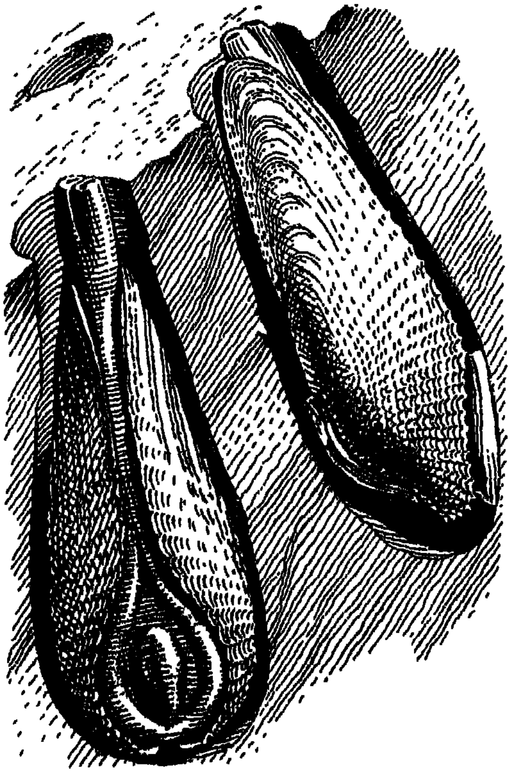
Other animals also settle on the rocks in this way, and some of the sponges form a thick covering, especially in shady places. Most people do not think of sponges as animals because they think of the one they use in the bath. This is actually the skeleton of a sponge that lives in tropical seas. The skeletons of many of the British sponges, unlike that of the bath-sponge, are made of flinty needles instead of being soft and flexible.

One of the sponges that you can easily find on the rocks is the bread-crumb sponge, so called because it crumbles fairly easily when you handle it. All over its pale yellow or greenish surface are countless tiny holes into which the sea-water flows. Once inside the sponge, all the goodness is strained out, and the water escapes again through larger holes at the top of small, volcano-shaped bumps that are dotted about all over the sponge.

ROCK-BORING CREATURES

There are several different kinds of sponge; one of them is especially remarkable because, in addition to straining the sea-water, it also bores holes in the rocks and the shells of molluscs. Its body is quite soft, and no one really knows how it does this, but scientists believe that it pours out an acid which slowly wears a pit in the rock. Then the sponge grows into this pit and, repeating the process, enlarges it into a tunnel. Sometimes you may find oyster-shells that are riddled with the holes that these boring sponges make to protect themselves from the violence of the waves.

One of the most interesting of the



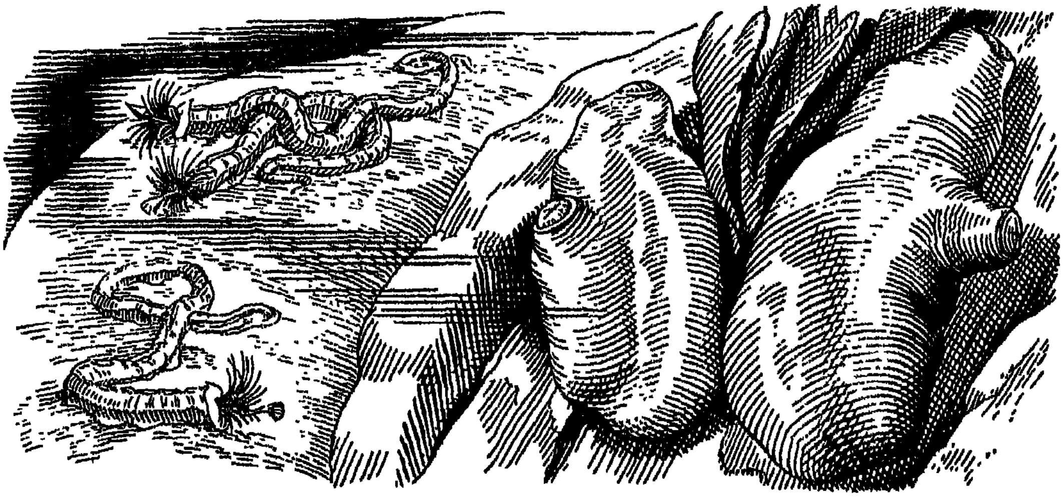
Though its shell is thin and delicate the piddock can burrow into rock, where it makes a home. Here it filters the goodness from the sea-water and is one of the few seashore animals that can make a light.

animals that are able to bore into rock in this way is the piddock. This strange bivalve mollusc has thin, delicate shells which bear on their outside a few sharp teeth. By gently rubbing these teeth against a rock it slowly bores a tunnel into it. Whether it enters the rock because its shell is thin, or whether it has a thin shell because the rock protects it, we do not know, but once in its burrow it makes itself comfortable, and even provides itself with a light. Very few shore animals can make light in the way that deep-sea animals can, and it seems to be no use to the piddock, for, like so many other molluscs, it finds its food in the sea-soup that it drinks.

These piddocks and boring sponges do not do nearly as much harm as the so-called shipworm. This animal does not live in the rocks, but bores its tunnels into all kinds of timber in the sea. It is not a worm, but a bivalve mollusc, though to look at its long white body you would not think so, for all that remains of its bivalved shells is its front end, which it uses as a boring tool.

Shipworms lay millions of eggs, which hatch into tiny swimming larvæ. These larvæ change into shipworms, and when they first settle down on some timber they are very small and, therefore, make only small holes. Once they have entered the wood, on which they partly feed, they grow, and make their burrows larger as they go. They cannot leave these burrows even to try the taste of other timbers, and if you cut a shipworm out of a piece of timber it is unable to enter it again. Another strange thing is that no shipworm has ever been known to enter the burrow of another, however riddled with worms the timber may be. In this way they do serious damage; sometimes ruining the timbers of a wooden ship; sometimes causing the wooden supports of piers and breakwaters to come crashing down. The wood that shipworms feed on is not very nourishing, and they brighten their dull diet with diatoms and small animals that swim in the water that flows into their burrows.

The strangest of the animals that live on sea-soup are the sea-squirts. Some



Once these rock worms (LEFT) *and sea-squirts* (RIGHT) *have settled on a rock or other solid object under water they never move again. They live entirely on microscopic animals and plants that they filter from the sea-water. The rock worms protect themselves from drying up when the tide leaves them uncovered, and from the waves, by the shell-like tubes in which they live. The cases of sea-squirts are unusual because they are made partly of a pulpy paper-like substance.*

of these animals live in colonies and form sheets of blue-grey jelly on the rocks, while others look like small bags of stiff grey jelly. Sea-squirts cannot move about, but are found sometimes on floating seaweed. They all have two mouths, and when you pick them up they shrink in your hand and squirt out a jet of water like a self-emptying bath-sponge.

Like many other stationary animals, sea-squirts have larvæ that swim freely in the water. These larvæ are very active little animals, looking something like tadpoles. They have a head, body and tail, and even the beginnings of a backbone; they seem well on the way to becoming quite respectable little fish. Then suddenly they change, each one settles down on its head, loses its tail, and turns into an almost shapeless bag of jelly, remaining so for the rest of its life.

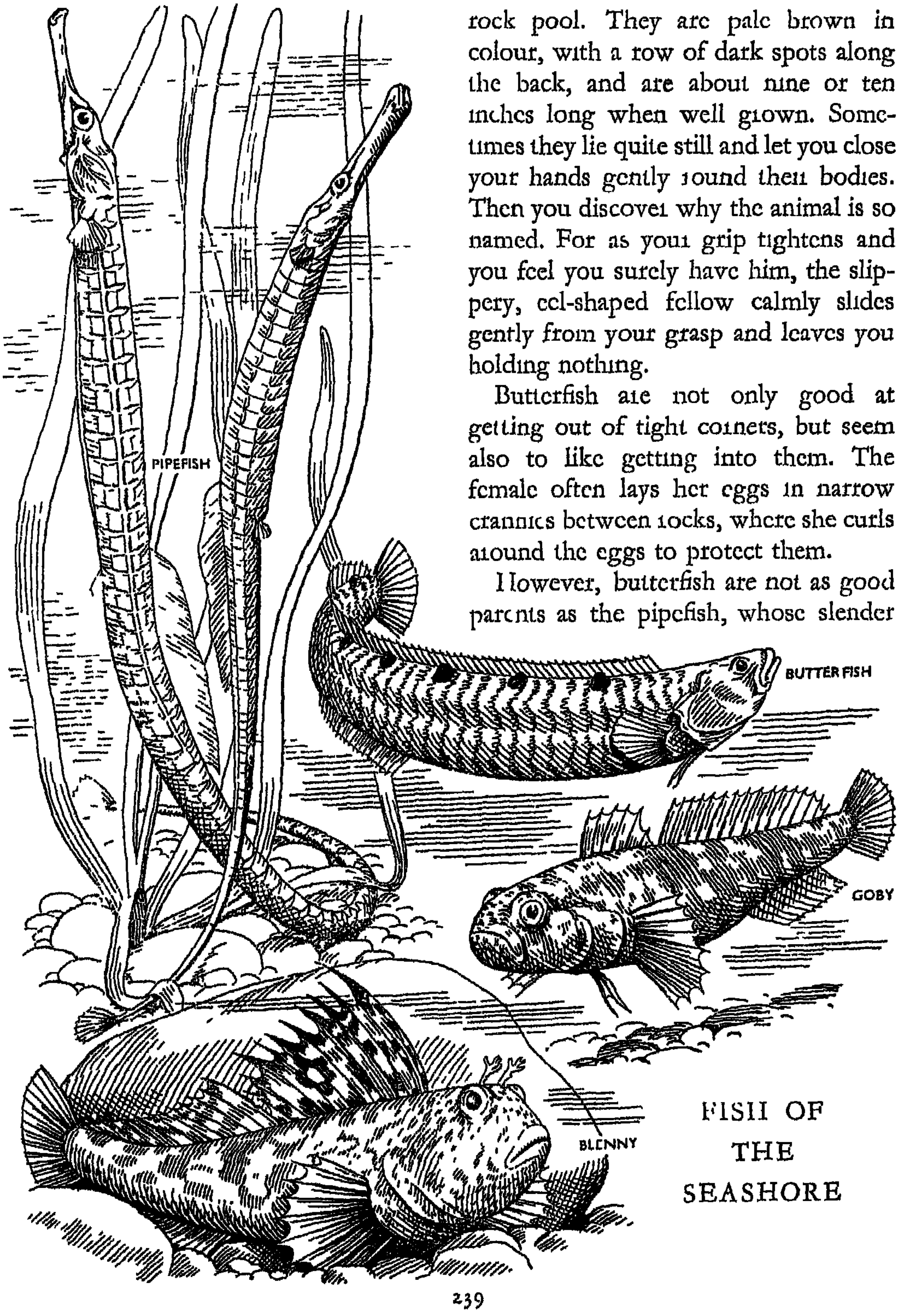
Sea-squirts, then, are not fish, and neither are many more of the creatures that live in the sea. There are, in fact, more animals in the sea which are not fish than those which are. Only the animals that have gills, fins, and a backbone inside their bodies are real fish.

Some fish, like herring and mackerel, live mainly on the sea-soup, but others, such as dogfish and skate, prefer something more solid. Some fish like the open sea, but there are a few that you can often find in the rock pools. All these are active fellows who love to wriggle into the chinks between the rocks. There are butterfish and gobies, blennies and pipefish, and you may even find an occasional sand-eel or small flatfish.

Butterfish make hurried little ripples in front of your feet as you make your way through the shallow water of a rock pool. They are pale brown in colour, with a row of dark spots along the back, and are about nine or ten inches long when well grown. Sometimes they lie quite still and let you close your hands gently round their bodies. Then you discover why the animal is so named. For as your grip tightens and you feel you surely have him, the slippery, eel-shaped fellow calmly slides gently from your grasp and leaves you holding nothing.

Butterfish are not only good at getting out of tight corners, but seem also to like getting into them. The female often lays her eggs in narrow crannies between rocks, where she curls around the eggs to protect them.

However, butterfish are not as good parents as the pipefish, whose slender



FISH OF
THE
SEASHORE

body may be a foot in length. It floats half upright in the water, and sways along rather than swims. For this reason it resembles the gently swaying seaweed among which it lives, and this protects it from many dangers.

When pipefish have a family the mother lays the eggs but the hard work of caring for them is left to the father. He is well fitted for his work, for on his front he has a pouch into which he packs the eggs. He carries them about with him in this way and looks after them. When the little fish hatch they show their gratitude to him by curling their tails lovingly round him, but pay no attention to mother.

In the shore pools, too, you sometimes find the ferocious little gobies. These fish, which are a good deal smaller than butterfish or pipefish, show the same sort of affection for their young offspring.

FISH IN ROCK POOLS

All these fish like the chinks and crannies that they find in the rocks, and this is especially true of another fish—the blenny. This fellow is also a fond parent and lays its eggs in empty holes and corners, where it mounts guard over them. Sometimes it uses an empty whelk-shell, but counts itself a very lucky blenny if it can find an old jam-jar or empty milk-bottle.

Except for an odd sand-eel or occasional flatfish, these are about the only fish that you find hiding in the rock pools. If you want to catch larger fish, you will find the best places farther out to sea. Many fish feed on sea-soup drinkers such as molluscs, and not only have powerful jaws which bear strong teeth, but extra teeth down their throats as well. Besides the carnivorous fish, other animals, too, feed on molluscs and the other sea-soup drinkers. For instance, whelks feed on winkles, just as starfish attack cockles and other bivalve molluscs.

HOW STARFISH FEED

Everyone knows starfish, and some people still believe that they can harm you if they crawl over your foot. Though they are quite harmless to humans, they do a great deal of damage to mussels, cockles, and oysters.

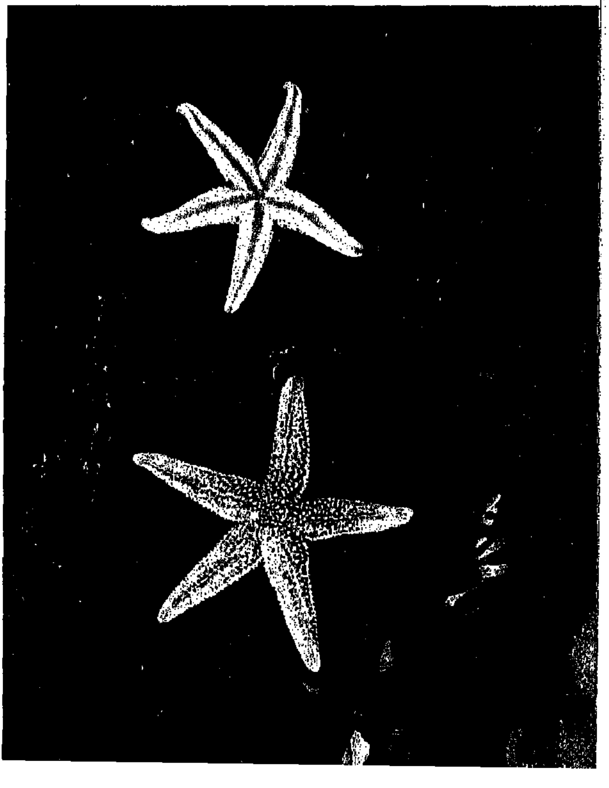
If you turn a starfish over you will see that it has rows of white suckers on each of its five arms. These suckers are hollow and lead into canals inside the animal's body which are full of water, and by filling or emptying these suckers it can push them in or out. And by gripping the sand or rock with these suckers the starfish crawls along.

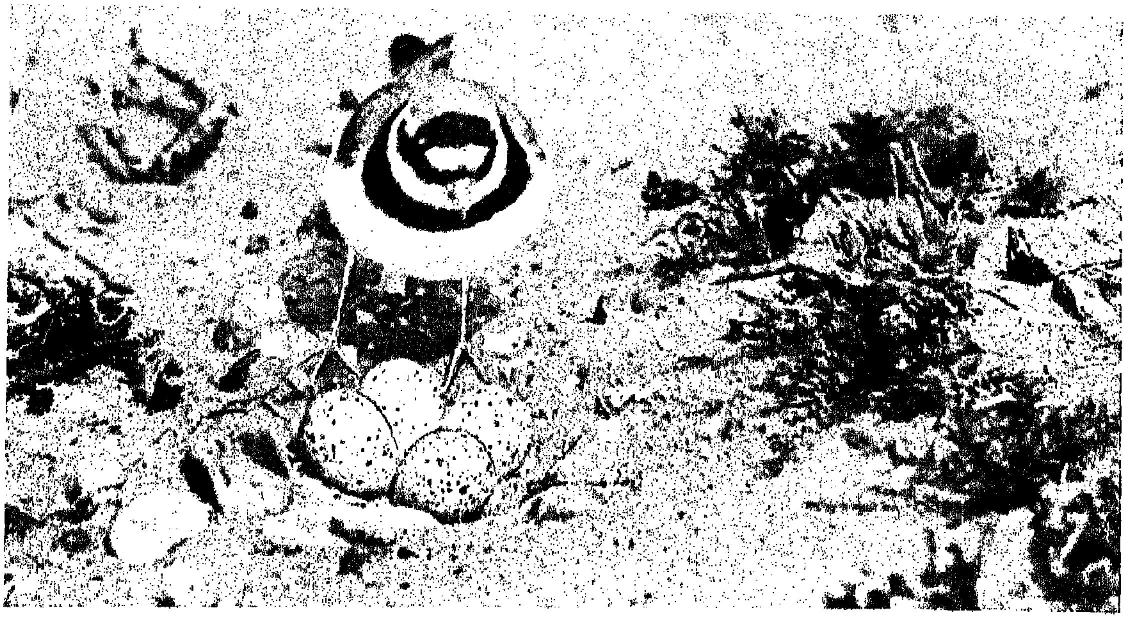
In the centre of the starfish, among the suckers, you will see the animal's mouth, and at meal-times it has a strange way of using it. When a starfish finds a cockle, mussel, or oyster it stands over it with its five arms outstretched. It turns the unlucky cockle on edge and grips the shells with its suckers. At once the cockle, sensing the danger, snaps shut, and from inside grips its shells tightly together. You can test the mollusc's power, for even with a stout-bladed knife and a pair of strong hands it is not easy to open it.

But this does not worry the starfish,

SEAWEEDS

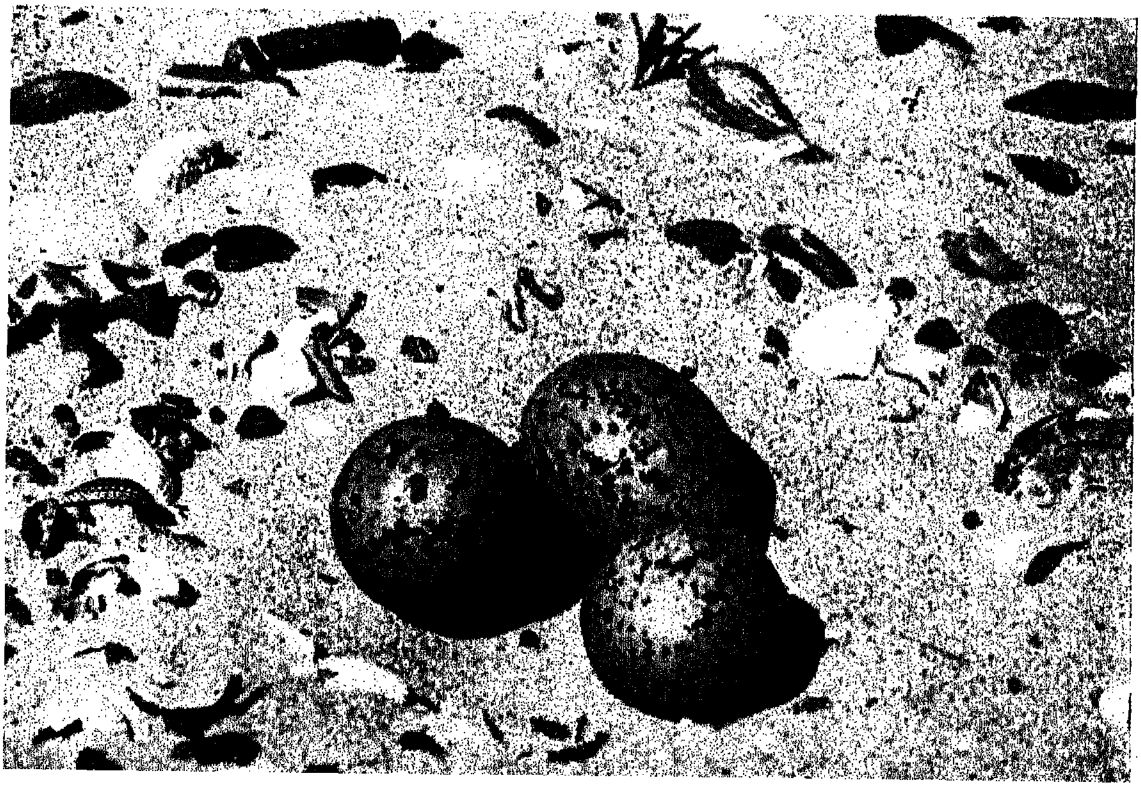
Two kinds of brown seaweed are shown above. On the left is the well-known bladder-wrack, the air bladders of which burst easily when pressed with the fingers. Beside it is the serrated wrack, so called because the edges of its leaf-like fronds are jagged. Often the serrated wrack is found lower down the beach than the bladder-wrack, for seaweeds show preference for their own particular level below high-water mark. Seaweeds have no roots and are stuck to the rocks by sucker disks. As they grow they branch repeatedly. Instead of flowering they produce masses of orange-coloured jelly-like spawn from small holes in the fronds. The spawn consists of tiny round eggs which roll hither and thither in the currents before settling on rocks and growing into seaweed. In the picture on the right is shown a third kind of seaweed, the channelled wrack. On it are two starfish, the upper one of which has been turned over to show its lower surface. On this are rows of white sucker-like feet which the starfish uses to grip the sea floor as it moves along.

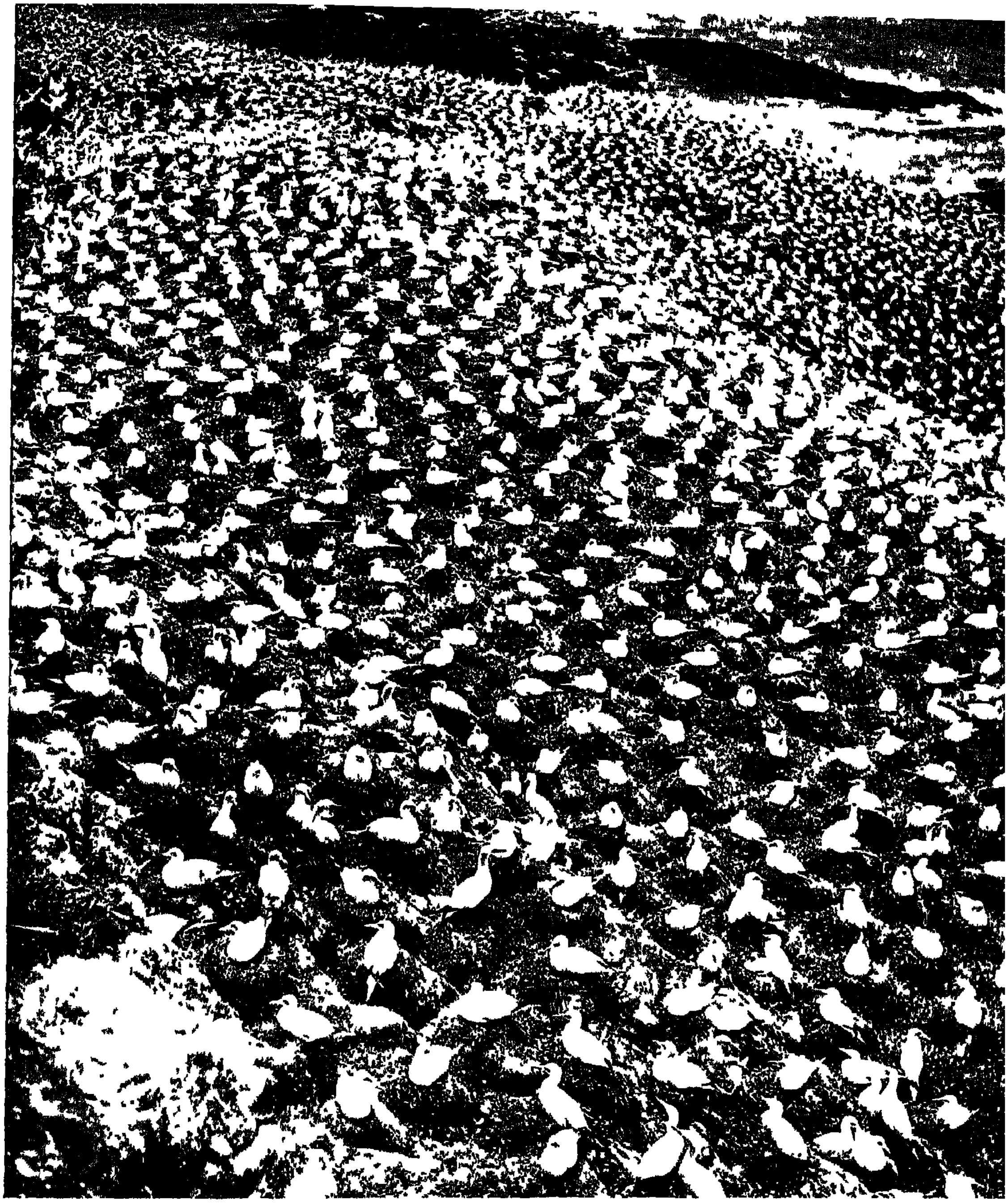




BIRDS THAT NEST ON THE SEASHORE

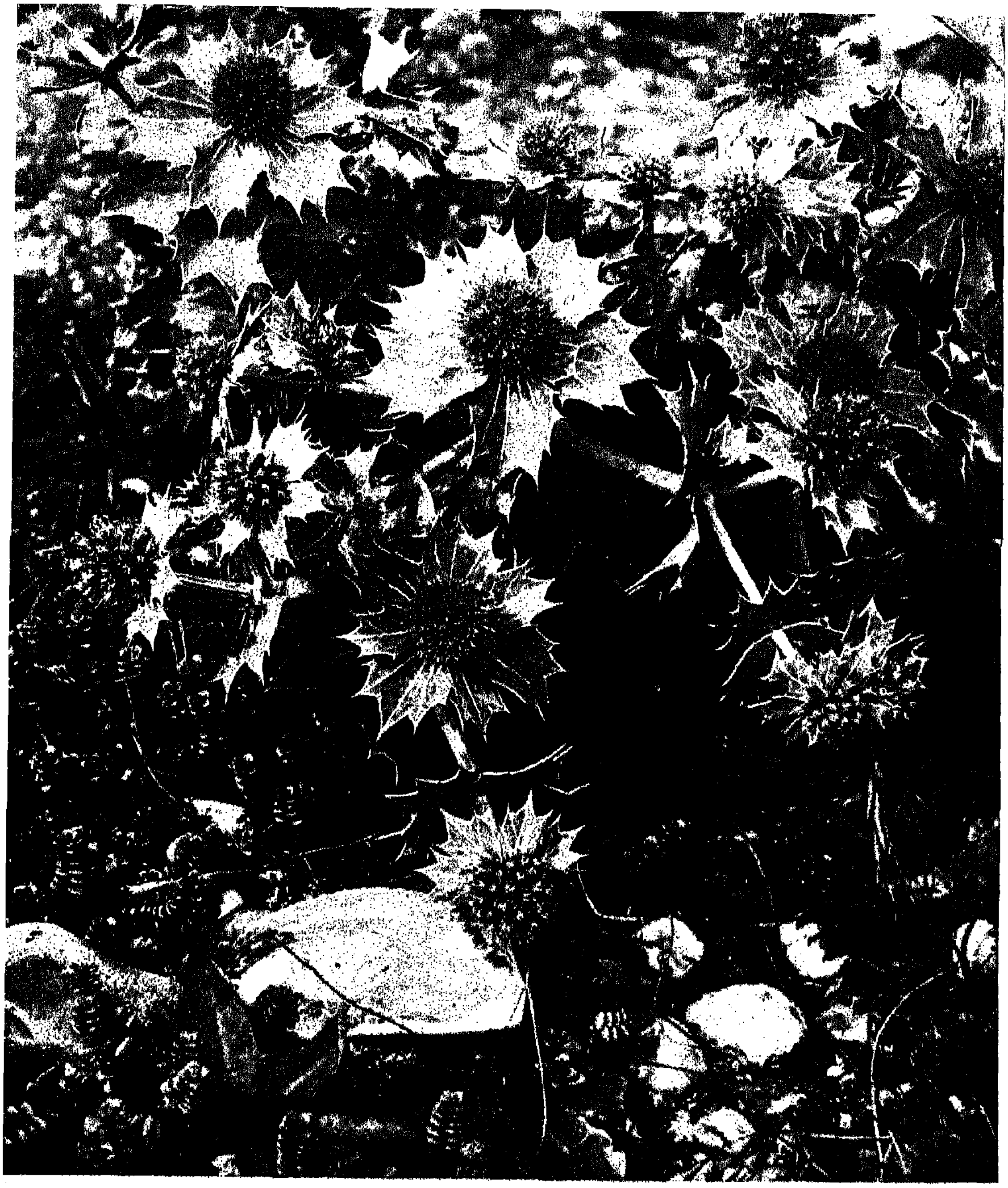
The ringed plover is one of the wading birds. It is sometimes found inland beside lake or river, but more usually on the sea-coast. Its nest (shown above*) is little more than a shallow hollow among the sand and pebbles of the shore. The eggs are yellow with brown mottling, so that they blend with their surroundings and are hard to see. Like the ringed plover, the oyster-catcher also lays its mottled eggs on the seashore* (below). *Oyster-catchers are so called because they live on oysters and other molluscs. They also eat small fish and sometimes worms and shrimps which they catch in the shallow pools which are left behind on the beach when the tide goes out.*





GANNETS NESTING

Though the birds in this great colony look small, in flight the gannet measures nearly six feet from wing tip to wing tip. The nests are made of seaweed. When their single egg hatches both parent birds search for fish to feed the chick. The gannet can dive at tremendous speed and swallows the fish whole, often while under water. On return to the nest the food so caught is brought up again for the chick to eat. The young gannet has brown feathers, which are gradually replaced by the white adult plumage, the process being complete by the time the bird is about four years old.



PLANTS OF THE SEASHORE

The pebbles and sand of the seashore make poor soil. The salt from the sea makes living conditions for plants even more difficult. Nevertheless on the wilder parts of the coasts of Britain many plants seldom found elsewhere thrive. In spite of the bad soil conditions sea holly (above) *is able to take in water through the roots. The plant has a waxy covering which helps it to conserve this water and as the season advances this waxy covering becomes thicker, giving the stems and leaves of the plant a glossy blue bloom. In the foreground on the left is sea purslane, which stands up to the dry salty conditions by having fleshy leaves and stems in which it stores water taken in during rain.*

which quietly grips each shell and pulls. At first nothing happens, for the cockle is stronger than the starfish. But the starfish goes on pulling, for what it lacks in strength it makes up for with endurance, and in the end a slight gap appears between the cockle's shells. Then from the starfish's mouth dribbles a stream of fluid through the gap and into the cockle shell. This is the final blow, for the fluid kills and partly digests the poor mollusc, so that its shell gapes widely open and a tasty meal is spread for the starfish.

Starfish have no teeth, and no one can pretend that they have good table manners, for not only do they dribble on their food before they eat it, but they stand over it and turn their stomachs inside out through their mouths on to it. This digests the food still farther, and the stomach wraps itself around the soupy mass so formed, gathers it into its folds, and slithers back with it through the animal's mouth into the interior of its body.

ENEMIES OF THE STARFISH

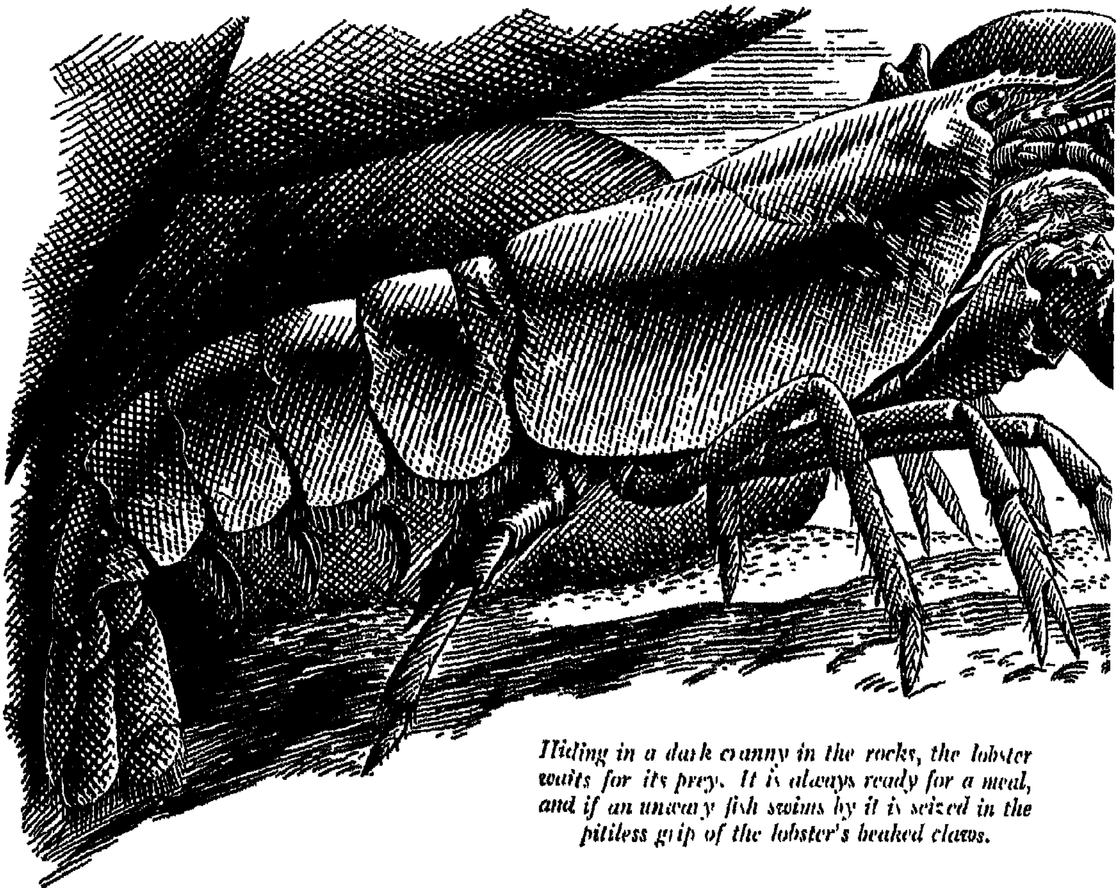
Starfish lay many eggs, and the youngsters, like their parents, have healthy appetites. These starfish larvæ are microscopic, and as they swim about in the water millions of them are eaten by cockles, mussels, and oysters. You can see how those that escape and grow up take revenge on the molluscs for the deaths of their little brothers and sisters. Once grown up they are difficult to kill, and heal themselves easily if wounded. If a starfish loses one of its five arms it soon grows a new one; even if it loses them all it can grow a complete new set and go on doing damage in the oyster-beds. To make matters even worse, each of the limbs that the animal loses can grow into a complete new starfish.

The common starfish has five arms, and many of its relatives show the same five-rayed construction. For instance, you sometimes find the brittlestars, which also feed on molluscs, in rock pools. These animals have arms which are more sharply divided from their disc-like bodies than are those of starfish. A brittlestar can cut off these arms so readily that it is difficult to catch; for if you hold it by one of its arms, it leaves it wriggling in your grip, and glides rapidly into hiding using the remaining four limbs.

LOBSTERS AND CRABS

Other common carnivorous animals are lobsters and crabs, which people sometimes call shellfish. They are, of course, not fish, and their shells are very different from those of molluscs, which are also often wrongly called shellfish. Instead of having a hard skeleton like a cockle or whelk, theirs is flexible and covers the body completely. These animals are called crustaceans, and they differ from molluscs in having, among other things, several pairs of legs. Besides lobsters and crabs, the other common seashore crustaceans are shrimps and prawns.

If you find a lobster in a rock pool you will notice that its shell is jointed in many places, so that the animal can move freely. This jointed armour not

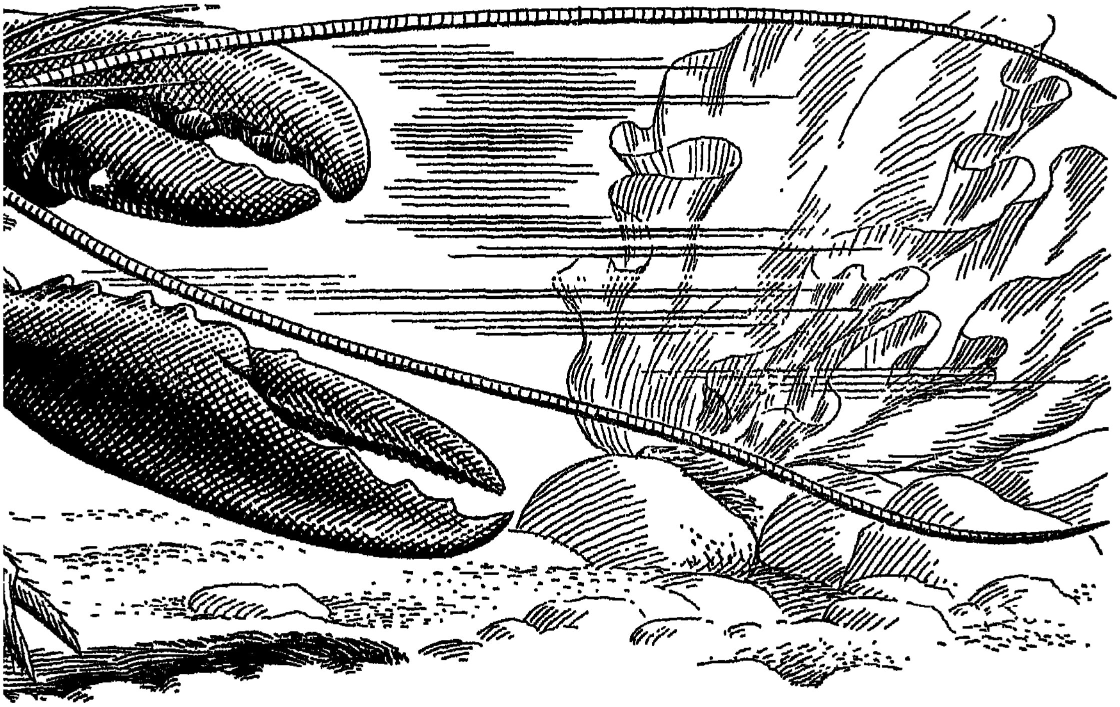


Hiding in a dark cranny in the rocks, the lobster waits for its prey. It is always ready for a meal, and if an unwary fish swims by it is seized in the pitiless grip of the lobster's beaked claws.

only protects the lobster from the waves, but is also a good defence against many enemies. Its one great disadvantage is that it does not stretch when the animal grows. So, at intervals, growing lobsters have to shed their armour and grow one a size larger. Shedding the shell is called moulting, and when the animal moults in this way it is in great danger; so before doing so it hides away under a rock. Then a large split appears across its back and, humping itself up, it gradually pulls both its front and hind ends out of the shell.

The new shell is still soft when this happens, and it stretches so that the animal can grow. So the lobster has to remain in hiding until it hardens, for there are too many animals about which have a taste for lobster.

When the lobster comes out in its new blue armour it wanders about over the sandy sea-floor and, if frightened by an enemy, it suddenly jerks its hind end forward under its body, rows itself suddenly backwards and disappears into a dark cranny in the rocks. Here it waits until the danger has passed. Always it is on the look out for something to eat. Its eyes at the ends of stalks on its head move around as the animal looks this way and that, and it waves its long,



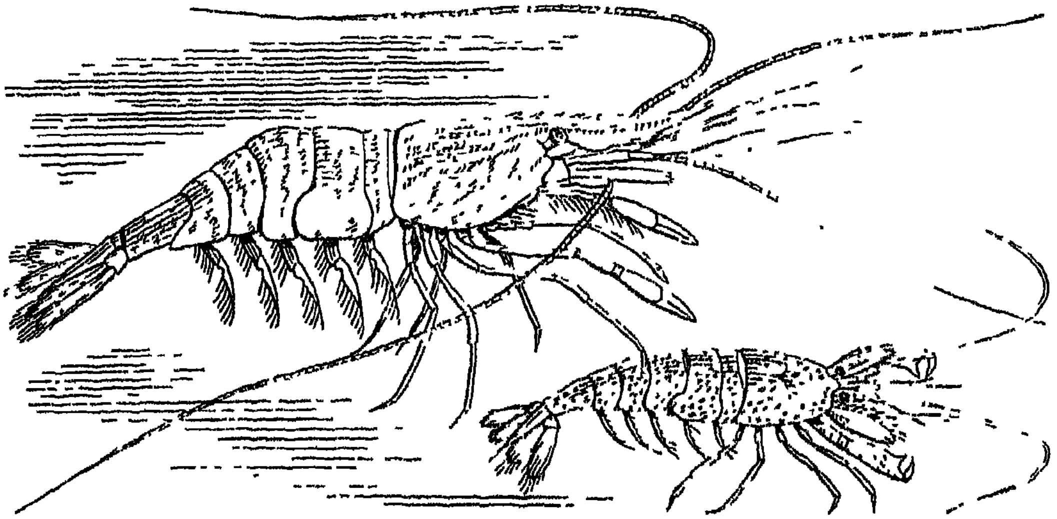
sensitive feelers. When something swims too close the lobster snaps at it with its powerful beaked claws, and you can see its jaws working in anticipation of the meal.

Lobsters will go to great trouble to get the food they really love, and nothing tempts them more than a nice piece of really stale fish. They will crawl through quite narrow openings for it. This often leads them into a lobster-pot, and they find that they are unable to get out again before the fisherman comes to collect them. When cooked they turn the pink colour they are when we see them in shops.

Lobsters can see and smell their food, and scientists have found that they also have a good sense of balance, for they have balancers on their heads which tell them which way up they are. These balancers consist of small, round, bristle-lined cavities containing sand grains that roll about in them. While the animal is on an even keel the sand grains lie still on the bristles, but if it turns over at all the sand grains roll and come to rest on some other bristles. This is how the animal knows that it is not level, and it soon puts matters right. But every time the lobster moults it sheds the lining of these balancers, and the sand grains, too. So until it has picked up some new sand grains it has a poor sense of balance.

So a scientist tried an experiment. He waited until a lobster was just about to moult, and quickly transferred it to another tank of sea-water, the bottom of which was covered by a thick layer of iron filings instead of sand.

The lobster hid under a stone that the



Prawns are much larger and more brightly coloured than shrimps. They are easy to see when the current and tides wash them inshore; shrimps are difficult to see as they are sandy coloured and show up only when they move. Both change colour when cooked and are good to eat.

scientist had placed there and moulted, and so lost its sand grains. Then it searched around for something to put into its balancers; and since all it could find was iron filings, in they went. But the scientist had not finished his experiment. He put the lobster back into an ordinary tank, where the lobster found the iron filings quite satisfactory—until the scientist brought up to the side of the tank a powerful magnet. This made the iron filings in the lobster's balancers fly to one side, and so gave the poor animal the feeling that it had turned on its side, although it could see that it had not. We are not told what the lobster thought about all this, but the poor thing rolled over and staggered about until the magnet was removed.

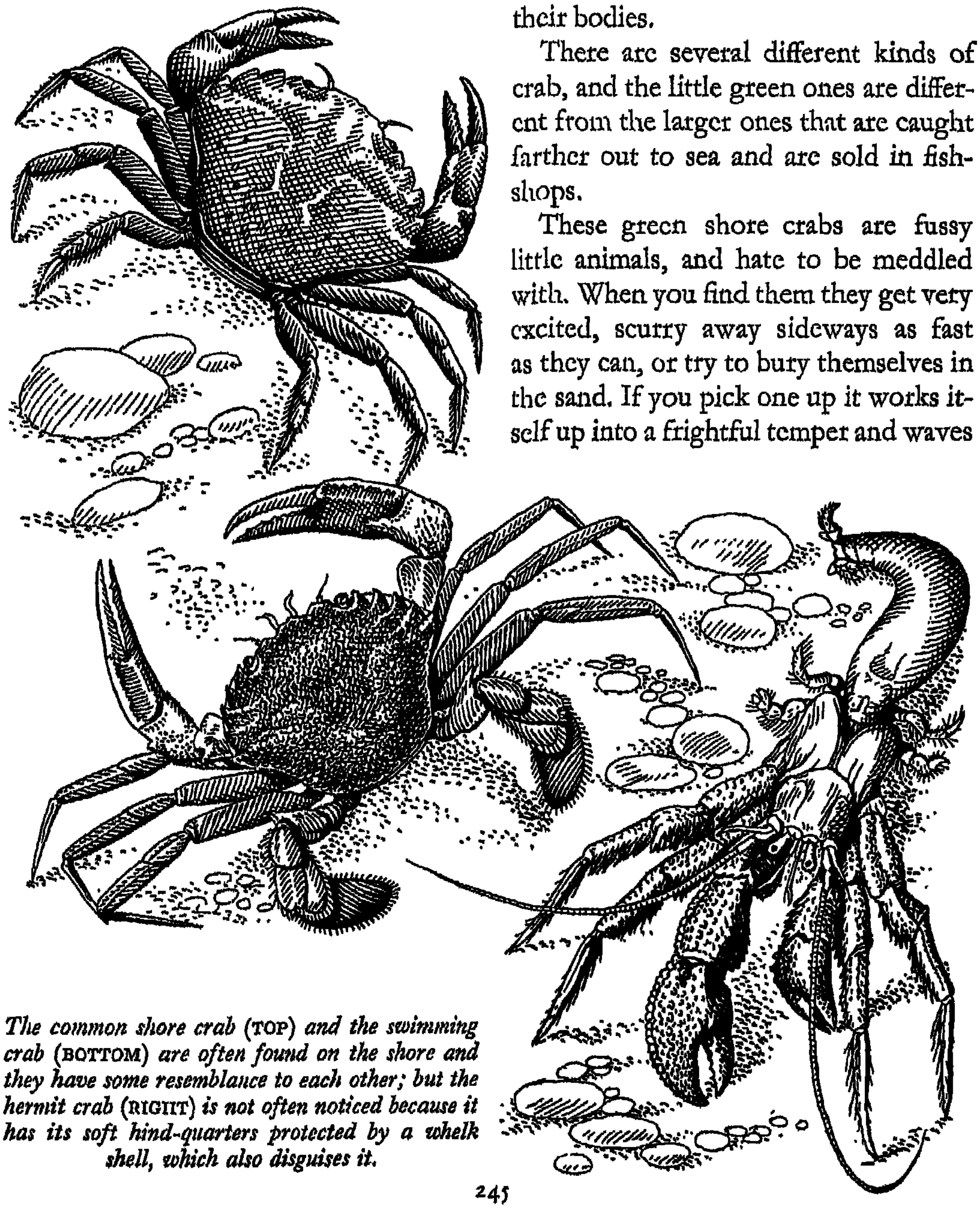
Lobsters lay a large number of eggs, and think nothing of producing eighty or ninety thousand at a time. For several months they carry these eggs with them underneath their bodies and, when they hatch, out come tiny swimming larvæ that are so clear and glassy that you can hardly see them. But hungry fish seem to see them easily enough and eat thousands of them. Many escape, however, and moult several times as they grow and turn into grown-up lobsters.

Shrimps and prawns are crustaceans and are similar in appearance to lobsters, though a good deal smaller. You often find shrimps in rock pools, but prawns like deeper water, and come close to the shore only when they are carried in by strong currents. Shrimps are difficult to see, as the colour of their bodies blends well with the sand at the bottom of the rock pools, but you notice them as they flit through the sunlit shallows, and they are easy enough to catch in a net. Like lobsters, they change colour when they are cooked, turning a brownish pink. Prawns also change colour in this way, and go pink like lobsters.

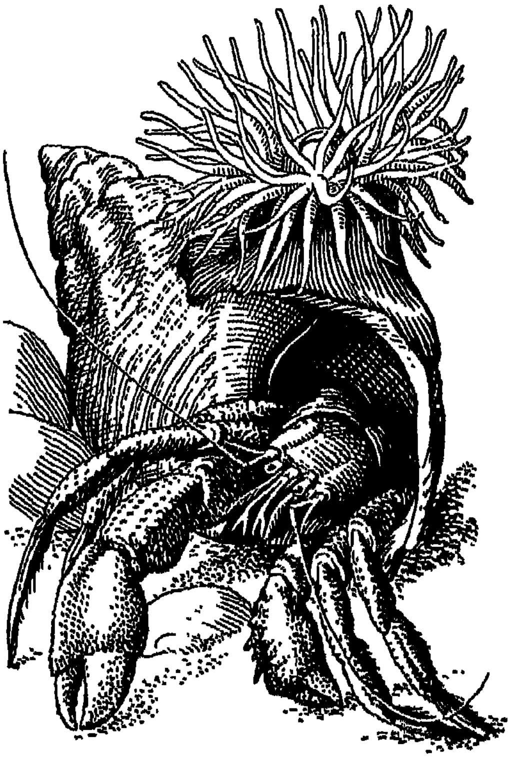
The little crawling crabs that you find in the rock pools are so different in shape from shrimps, prawns, and lobsters that you might not think they were crustaceans at all, except that they have the same kind of legs and beaked claws. But they are all really very much alike, and the main difference is that the lobster tribe have their hind end straight, while crabs have it bent forward under their bodies.

There are several different kinds of crab, and the little green ones are different from the larger ones that are caught farther out to sea and are sold in fish-shops.

These green shore crabs are fussy little animals, and hate to be meddled with. When you find them they get very excited, scurry away sideways as fast as they can, or try to bury themselves in the sand. If you pick one up it works itself up into a frightful temper and waves



The common shore crab (TOP) *and the swimming crab* (BOTTOM) *are often found on the shore and they have some resemblance to each other; but the hermit crab* (RIGHT) *is not often noticed because it has its soft hind-quarters protected by a whelk shell, which also disguises it.*



Disguising the empty whelk shell in which a hermit crab lives is a sea-anemone, shown at the top in this picture. The hermit crab, shown partly out of the shell, pays for this protection by sharing crumbs from its food with the anemone. Sometimes a small sea-worm shares the whelk shell with the crab and eats some of the food it catches.

its legs about and blows bubbles at you, but if you hold it by one of its legs it escapes easily by cutting itself adrift and leaving the leg behind in your hand while it makes off on what are left.

This ability to cut off its limbs in this way serves the crab well when it has a difference of opinion with another crab. For they are not only fussy, but quarrelsome little beasts, too, and these differences seem to happen quite often. You can always tell when one has taken place, for the sand is littered with legs of all shapes and sizes that the angry little crabs have left behind. Off they stump to nurse their wounds and to grow some new legs, for they really need a full set, even though they seem ready enough to part with them.

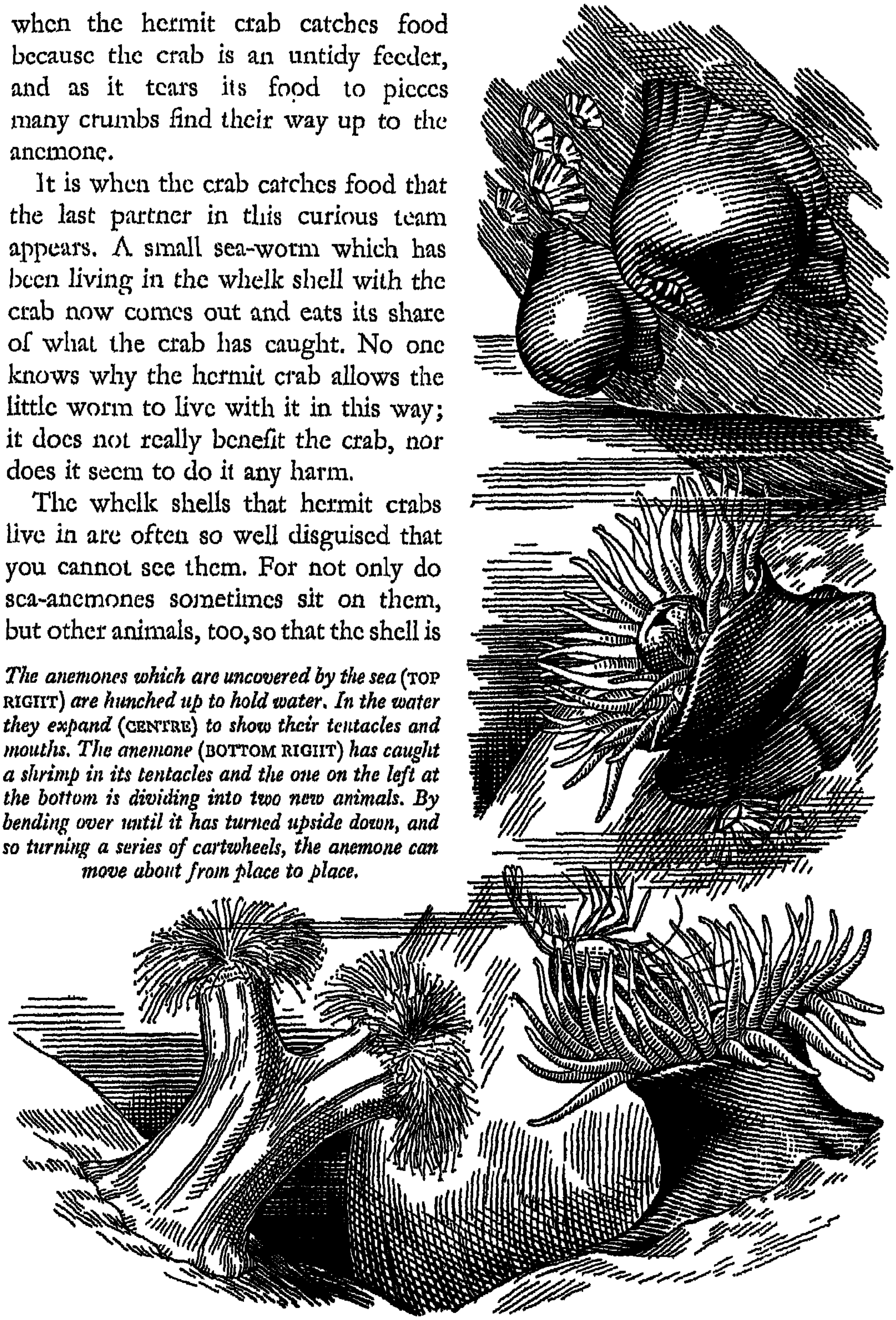
Crabs lay many eggs, and these, like those of lobsters, turn into tiny, transparent, swimming larvæ, which moult several times before they grow up and learn to walk. Along with ordinary shore crabs you will find some of the little swimming crabs in the rock pools. These are similar to shore crabs, but you can always recognize them, for their hind legs are paddle-shaped and fringed with bristles.

One of the most interesting crabs is the hermit crab, for it has the unusual habit of joining forces with some of the other animals. The animals with which the hermit crab joins up are a curious collection. The hermit crab itself looks rather like a small lobster, except that one of its claws is somewhat larger than the other and its hind end is soft and unprotected. To remedy this the hermit crab borrows an empty whelk shell, into which it puts its unprotected parts. If it sees danger approaching it recedes into the whelk shell and closes the entrance by wedging its larger claw across the gap.

On the whelk shell which the hermit crab has taken over is often to be found one of the beautiful flower-like animals called sea-anemones. By sitting on the whelk shell the sea-anemone helps to disguise it, so that enemies which might attack the hermit crab pass by without seeing it. The sea-anemone benefits when the hermit crab catches food because the crab is an untidy feeder, and as it tears its food to pieces many crumbs find their way up to the anemone.

It is when the crab catches food that the last partner in this curious team appears. A small sea-worm which has been living in the whelk shell with the crab now comes out and eats its share of what the crab has caught. No one knows why the hermit crab allows the little worm to live with it in this way; it does not really benefit the crab, nor does it seem to do it any harm.

The whelk shells that hermit crabs live in are often so well disguised that you cannot see them. For not only do sea-anemones sometimes sit on them, but other animals, too, so that the shell is



The anemones which are uncovered by the sea (TOP RIGHT) *are hunched up to hold water. In the water they expand* (CENTRE) *to show their tentacles and mouths. The anemone* (BOTTOM RIGHT) *has caught a shrimp in its tentacles and the one on the left at the bottom is dividing into two new animals. By bending over until it has turned upside down, and so turning a series of cartwheels, the anemone can move about from place to place.*

completely covered. Barnacles especially settle on whelk shells and, as large numbers of these animals also sit on the surrounding rocks, the disguise is very effective.

SEA-ANEMONES

Just as hermit crabs spend most of their time quietly waiting for anything eatable to turn up, so the strange sea-anemones and sea-firs do the same. Sea-anemones have soft, leathery bodies, and when the tide goes out you see them stuck on to the damp rocks, looking like round blobs of dark-red or brown jelly. By hunching up in this way they conserve their water until the tide covers them again, and you see them at their best in the clear waters of the rock-pools. For instead of being a small, round knob, the sea-anemone is now a short, stout pillar of red, with a fringe of slender, pointed tentacles at its crown. These tentacles stand out like the petals of a flower, and you can well understand how the animal came to be so named. Though the sea-anemone's gently waving tentacles are very beautiful, it has a better use for them than merely to please our eyes. For each of them is studded with batteries of tiny stingers which shoot out poisoned threads the moment they are touched. They are not powerful enough to hurt humans, but if a shrimp or small fish swims too close to the innocent-looking charmer it has a nasty shock as soon as it touches the tentacles.

The poisoned threads entangle it and also partly paralyse it, and as it recovers from its daze and tries to escape, the tentacles bend over inwards toward it and more of the stingers shoot out as they in turn come into contact with it. More of the tentacles join in, bending inward toward the animal's mouth, and stinging as they go. And so the poor shrimp is carried to the anemone's mouth, into which it disappears with a final pat on the back from the tentacles.

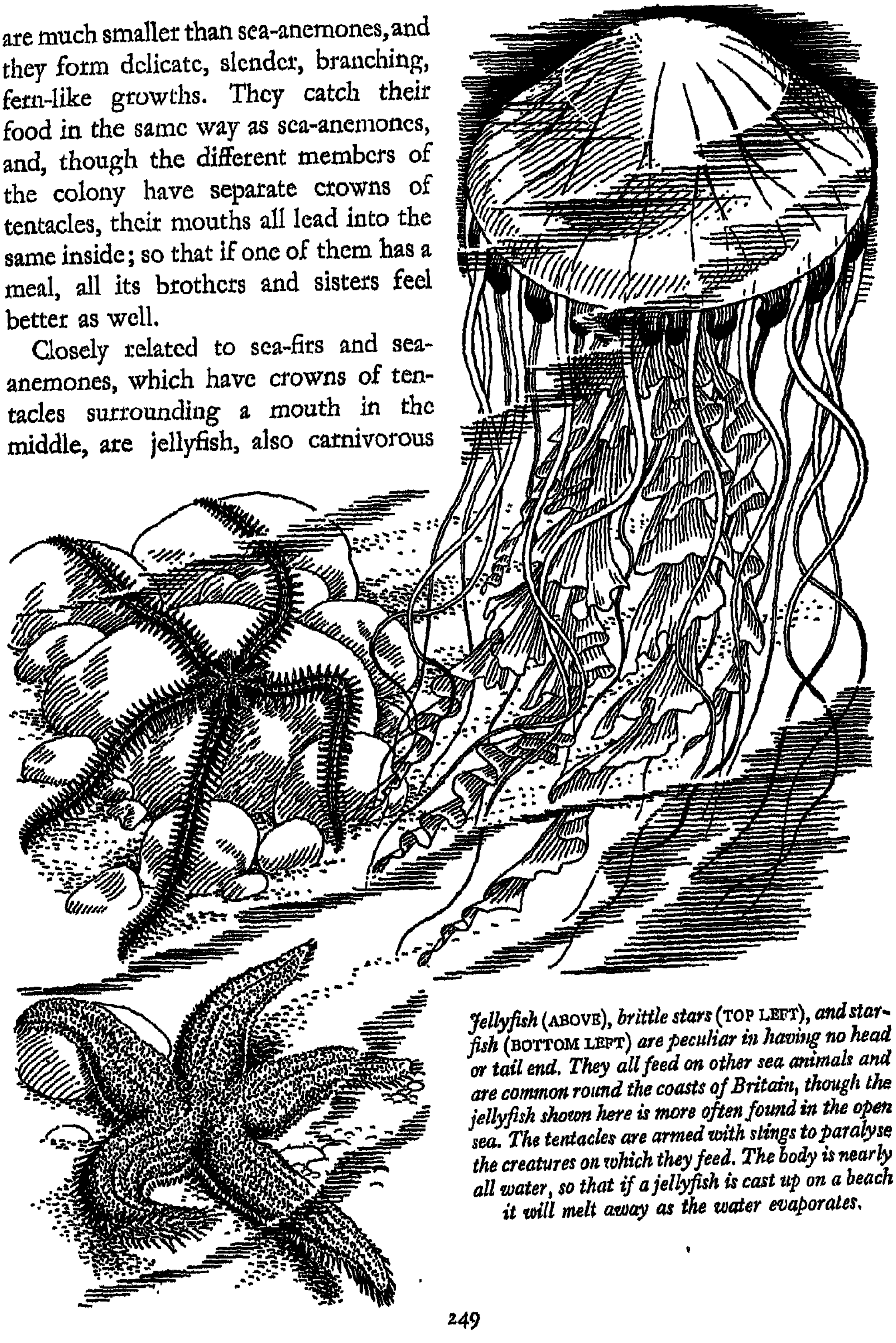
Anemones have a way of shuffling over rock on the flat sole of their pillar-box bodies. Sometimes it bends over, grips the rock with its tentacles, and slowly but surely turns upside down. Then just as slowly it bends over still farther, fixes its sole to a new place on the rock and lets go with its tentacles. This slow-motion cartwheel is by no means all it can do. For sometimes, when it is shuffling about, one half goes one way, while the other goes in the opposite direction. In this way the animal splits into two, and each half heals up and goes off on its own affairs.

SEA-FIRS

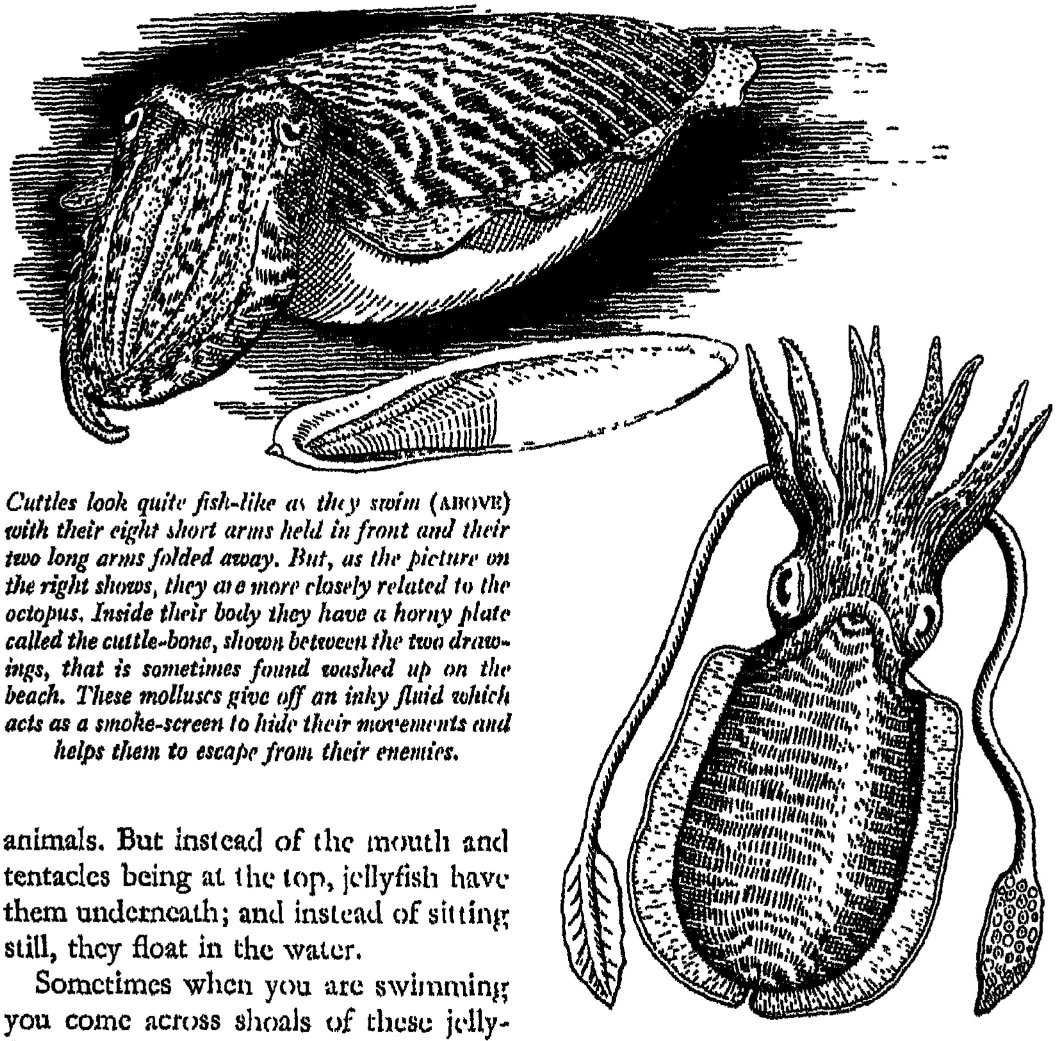
This is a simple way of having a family, and by cutting the sea-anemone into several pieces you can help it to have quite a big one. Put the pieces into a bowl of clean sea-water and trim off any ragged edges. Then next morning you will find that all the pieces, even including the trimmings, have grown into perfect new sea-anemones, complete with tentacles.

Many of the sea-anemone's relatives grow in this way, but the offspring do not separate. Instead you find them living together in the rock pools in colonies, and we call them sea-firs. They are much smaller than sea-anemones, and they form delicate, slender, branching, fern-like growths. They catch their food in the same way as sea-anemones, and, though the different members of the colony have separate crowns of tentacles, their mouths all lead into the same inside; so that if one of them has a meal, all its brothers and sisters feel better as well.

Closely related to sea-firs and sea-anemones, which have crowns of tentacles surrounding a mouth in the middle, are jellyfish, also carnivorous



Jellyfish (ABOVE), *brittle stars* (TOP LEFT), *and starfish* (BOTTOM LEFT) *are peculiar in having no head or tail end. They all feed on other sea animals and are common round the coasts of Britain, though the jellyfish shown here is more often found in the open sea. The tentacles are armed with stings to paralyse the creatures on which they feed. The body is nearly all water, so that if a jellyfish is cast up on a beach it will melt away as the water evaporates.*



Cuttles look quite fish-like as they swim (ABOVE) *with their eight short arms held in front and their two long arms folded away. But, as the picture on the right shows, they are more closely related to the octopus. Inside their body they have a horny plate called the cuttle-bone, shown between the two drawings, that is sometimes found washed up on the beach. These molluscs give off an inky fluid which acts as a smoke-screen to hide their movements and helps them to escape from their enemies.*

animals. But instead of the mouth and tentacles being at the top, jellyfish have them underneath; and instead of sitting still, they float in the water.

Sometimes when you are swimming you come across shoals of these jellyfish. They are hard to see in the water, for their bell-shaped bodies are clear and glassy, except in the breeding season, when they are ready to lay their eggs. Then their four horseshoe-shaped egg-bags go deep purple when the eggs are ripe. Jellyfish have no proper eyesight, and seem to have no sense of taste or smell. But spaced around the edge of the bell they have balancers like those of lobsters. This helps the jellyfish to keep the right way up, and as it bobs about in the water its fringe of tentacles waves about.

These tentacles are like those of sea-anemones, and with them little crustaceans are caught and popped into the animal's mouth underneath the bell. The stingers on the tentacles of big jellyfish are so powerful that if you bump against them you may get badly stung. When the sea is very rough, jellyfish are sometimes thrown up on the beach. They do not live long then, for out of water they are too weak to hold themselves up. Their bodies are really very frail, for they are nearly all water, so that the stranded jellyfish soon melt away in the sunshine.

THE CUTTLE-FISH

Another carnivorous animal that has tentacles and swims off-shore is the cuttle-fish. This fellow is not really a fish, though when you see its streamlined body and large, staring eyes you might well think it was. Cuttles are really molluscs which have completely lost their shells, and instead of having a foot, as cockles and mussels do, they have ten long tentacles, which they use for catching their food. These tentacles, unlike those of sea-anemones, are unable to sting, but are studded with suckers like those of the octopus, to which cuttles are closely related.

Cuttles are quite good swimmers, and as they move through the water they can change colour as rapidly as they need in order to blend with their surroundings. They like eating crabs and shrimps, and the fact that they can camouflage themselves in this way helps them to approach their prey unseen. It also protects them from their enemies, but in the case of real danger approaching the cuttle knows two tricks which help it to get out of trouble.

In front of its body, among its tentacles, it has a spout that points forward. If it sees something that it does not quite like, it squirts a jet of water out of this spout, and this propels it suddenly backward, where it can take a safer view of things. If things get really bad, and the cuttle finds that it must not delay, as it has most urgent business elsewhere, it uses this spout for laying a smoke-screen, and shoots out a great cloud of an intensely black inky fluid, behind which it makes off unseen.

Although cuttles have no shell inside their bodies, they have a hard, horny plate called cuttle-bone, which you sometimes find washed up on the beach. Artists make great use of these animals, for the inky fluid is made into a colour called sepia, and the cuttle-bone is useful for rubbing out mistakes in charcoal drawings.

SEA-CUCUMBER

Throwing out a smoke-screen is one way of confusing your enemies, but the cotton-spinner has another. This animal is sausage-shaped, and sometimes hides buried in the sand or lies on the sandy floor in the shadow of banks of seaweed. It is black above and yellow below, and has a tough, leathery skin with warty lumps scattered over it. Because of its appearance it is sometimes called a sea-cucumber, but if a hungry lobster decides to take a mouthful of it, it does what no cucumber can. For out of its hind end it shoots a great mass of its internal organs which, in the water, resemble a mass of white cotton threads. The lobster, becoming entangled in the sticky threads, has its mind taken off the sea-cucumber, which slides quietly away and repairs the damage to its inside.

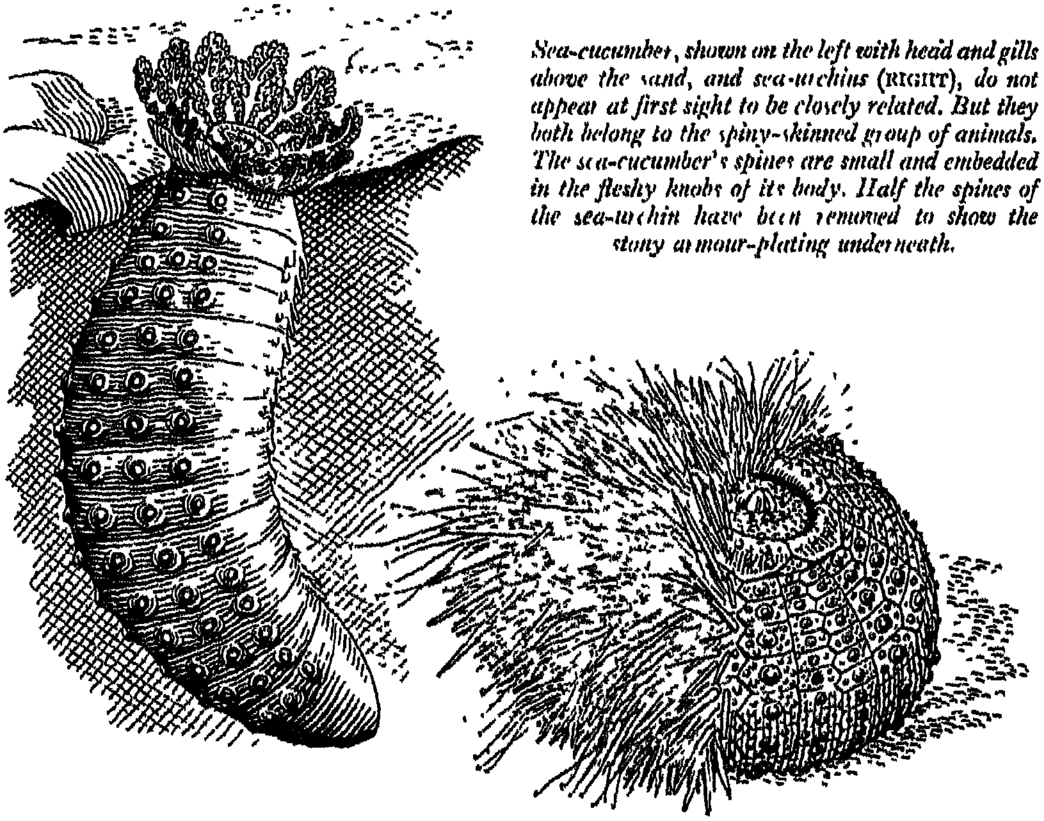
Sea-urchins are carnivorous animals of a kind different from most. They do not wait quietly for their food, like sea-anemones or sea-firs; nor do they actively chase their prey as do fish and cuttles. Instead they feed on the inoffensive barnacles, whose only means of defence is their stony shell.

Sea-urchins are related to starfish and brittlestars and, like them, show a five-rayed construction, but instead of having five arms separate, they have lifted them up over their bodies and, joining them together on top, have become ball-shaped instead of flat.

The sea-urchin's body is covered with a hard shell, on which its prickly spines are arranged in five rows. Between the rows of spines are five rows of suckers. The spines are used for keeping the animal clean by picking off any rubbish that falls on its body, and the suckers are for passing any odd crumbs of food that fall in the shell into the animal's mouth, which is under the body.

Sea-urchins can crush the hard barnacle-shells because they have five very powerful pointed teeth, which they poke out of their mouths. The sea-urchin not only uses its teeth for feeding, but even walks about on them. It pokes them out of its mouth, digs them into the sand, and, by wriggling them about, moves itself along.

Although sea-urchins eat many barnacles, they do not despise other kinds of food, and will even also eat seaweed if they can find nothing else. Like so



Sea-cucumber, shown on the left with head and gills above the sand, and sea-urchins (RIGHT), *do not appear at first sight to be closely related. But they both belong to the spiny-skinned group of animals. The sea-cucumber's spines are small and embedded in the fleshy knobs of its body. Half the spines of the sea-urchin have been removed to show the stony armour-plating underneath.*

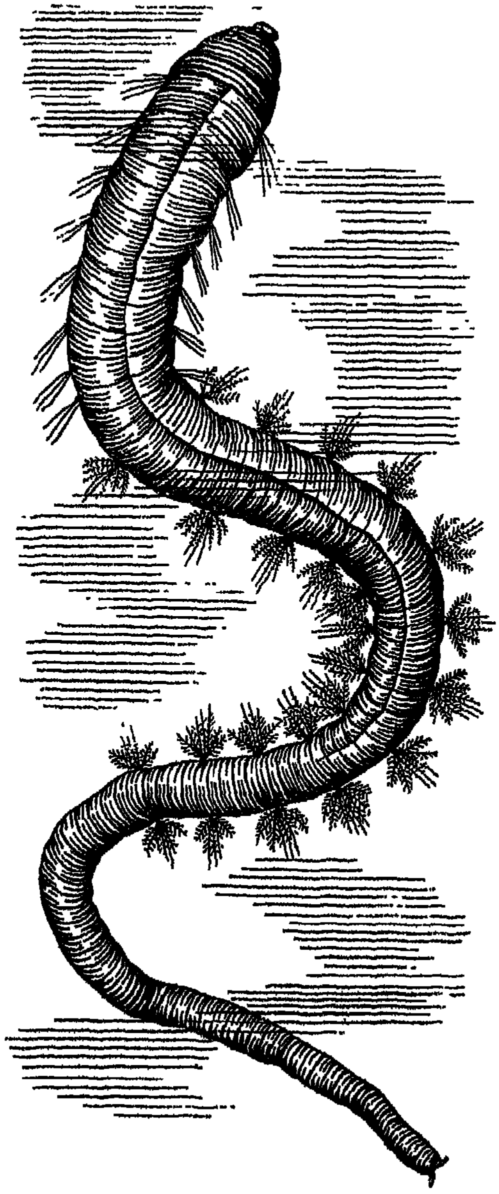
many other sea animals, they lay very many eggs in the spring, and the tiny, transparent larvæ swim about, as do those of mussels and oysters, by waving thousands of minute living lashes which they beat in rows on their bodies.

So far we have found out about several different kinds of sea animals. Some are molluscs, some are worms, some are crustaceans and some are fish. Like fish, many of these animals swim through the water, but a surprising number of them either stay still on the sea-bed or walk slowly about on it.

Some, like cockles and razor-shells, burrow in the sand in order to hide themselves from their enemies, but others burrow through it, eating mouthful after mouthful. As food, sand appears to be most unlikely stuff; but just as the sea-water contains more nourishment than you would think, so does the sand. For many of the diatoms, and also the tinier sea animals of the sea-soup, sink through the water and into the sand, where they form the food of a large number of burrowing animals.

Many of these burrowing animals are worms, and some of them, like the sand-mason worm, are brightly coloured. The burrowing worms that are best known are the lugworms, and when the tide goes out you can find them easily.

Here and there on the wet sand you find little heaps of sandy worm-castings shaped like those on lawns. Near each sandy coil you will see a shallow, round pit, and you will find that a lugworm lies in a U-shaped burrow between the casting and the pit. If you dig down



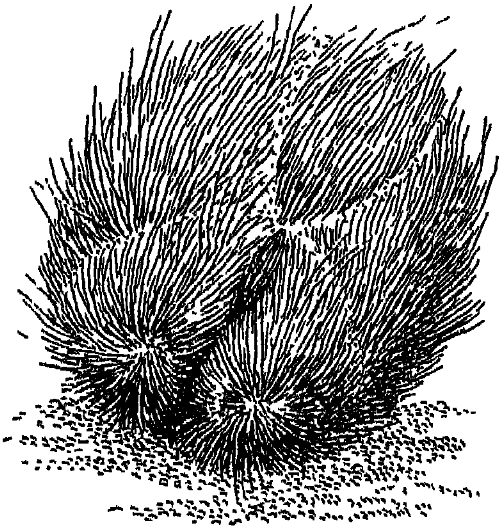
Lugworms spend their time eating sand and getting from it what goodness it contains. When the tide goes down the worm-casts which they leave on the wet sand are seen. These, together with a slight hollow in the sand of the beach above each worm's mouth, tell where they are hiding. When making its tunnel the lugworm pours out a yellow slime which binds the sand grains together and prevents the tunnel from collapsing. Lugworms are used by fishermen to bait their lines.

quickly you will bring up the lugworm, and, though he looks rather drab and sandy, he improves greatly if put in a bowl of clean sea-water. For he expands his beautiful, blood-red, feathery gills, and you see him as he is when the tide comes up.

Lugworms make good bait, and you often see people who like fishing, digging in the wet sand for them. You can see the worm's burrow as the spade breaks into it, for its wall is coloured yellow by the slime that the worm pours out. This slime sticks the sand grains together so that the tunnel does not fall in.

Sometimes when you dig in the smooth, wet sand looking for lugworms you find a beautiful bright-lemon-yellow animal that has a hard shell like a sea-urchin, and may be as large as a tennis ball. This is one of the heart-urchins and, like the sea-urchin, belongs to the spiny-skinned tribe of animals. It is not round, but gets its name from being somewhat heart-shaped. In the middle of its body you will see its little, round mouth and, like the sea-urchin, it can poke out its five teeth.

Heart-urchins feed on the living creatures in the sand, and nudge their way through it, taking gulps of it as they go. There is an unsolved mystery about them, for whenever you dig one up you find somewhere near in the sand a small brown bivalve mollusc. You do not find this mollusc living alone, and no one knows why it keeps the heart-urchin company, or whether the heart-urchin likes it there or not. But there it lives, and with these are many other animals, too, whose lives are spent in the wet darkness of the sands.



Heart-urchins are related to sea-urchins, but instead of being round are somewhat heart-shaped. They live buried in wet sand and are seldom seen alive unless they are dug out.

Somebody once said that there are more fish in the sea than ever came out of it. This is quite true, but it is also true that there are many more kinds of animal in the sea than most people think. When you see mollusc shells, cuttlebones or whelk egg-cases washed up on the beach, you will now know what they are and also something about the animals from which they come. But you will also know something about some of the other animals that live among the rocks, or buried in the sand, or in the deeper water farther out. These are only some of the animals you will find at the seaside, but if you decide to become a seashore naturalist, then your holidays will be interesting indeed.

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